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† In marine separate.

CORRECTION

MONTHLY WEATHER REVIEW, June, 1924, 52:333: In the column headed "Total wind movement," Los Angeles recorded "30,730" should be "3,730" miles.

MONTHLY WEATHER REVIEW

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SOME OBSERVATIONS ON THE CYCLONIC PRECIPITATION OF FEBRUARY 22–23, 1925, IN THE CENTRAL AND EASTERN UNITED STATES

By R. H. WEIGHTMAN

[Read before the American Meteorological Society, May 2, 1925, Washington, D. C.]

The first step in predicting any phenomenon is to understand the physical processes underlying its occurrence. The precipitation problem, important to mankind and attractive because of its difficulty, has received, therefore, much attention from meteorologists.

The causes of condensation and resulting rainfall are, as purely physical matters, fairly well understood. This can not as yet be said of the meteorological aspects of rainfall, though our knowledge of them is increasing rapidly. J. Bjerknes and H. Solberg, in their treatise on "The Meteorological Conditions for the Formation of Rain," show that:

> Adiabatic cooling by expansion is the most effective cooling process at least for larger air masses. Expansion of atmospheric air will again mainly be due to ascending motion, which rapidly brings the air from layers of high pressure to layers of lower pressure. Horizontal motion may certainly also bring air from high to low pressure, but the resulting expansion will be much smaller than that attained by vertical displacement. The effect of pressure changes in a horizontal current can thus only in exceptional cases cause rain. The predominating influence of ascending air motion reduces the meteorological side of the problem of rain formation to the following principal one: What are conditions for development of strong ascending motion. The solution of this problem gives the explanation for the cause of the greatest part of the occurring rainfall.

While we may explain why precipitation occurred after we know what changes in pressure distribution, temperature lapse rates, and other conditions have taken place, it is very difficult at times to tell from our current maps when and where precipitation will ensue during the succeeding 24 hours, and much more difficult to forecast it for the next 36 to 48 hours. The earlier forecasters in this country recognized certain types of barometric distribution, accompanying wind circulation, and other factors as being the forerunners of precipitation and they issued many very accurate and valuable forecasts before the processes were understood. Later, the general physical processes were explained.

More recently, Prof. V. Bjerknes has described these processes in the language of mathematics, explained them on thermo-dynamical principles, showed the idealized barometric types that accompany them, and provided strikingly appropriate names for certain important features of the pressure and wind systems. To him belongs the distinction of having brought together the best thought of meteorologists in Europe and this country concerning the structure and rain-producing processes of storms, combining them with his own special contributions into a *rationale* which has been an inspiration to meteorologists the world over.

The visit last year of Prof. V. Bjerknes, his son, Dr. J. Bjerknes, and Mr. M. A. Giblett, a member of the forecasting staff at London, provided the inspiration for the present study.

Before proceeding with an analysis of the disturbances which form the subject of this paper, a brief résumé of the Bjerknes polar front theory will be given. According to this theory, a cyclone consists of two essentially different air masses (see fig. 1). We have a warm current of

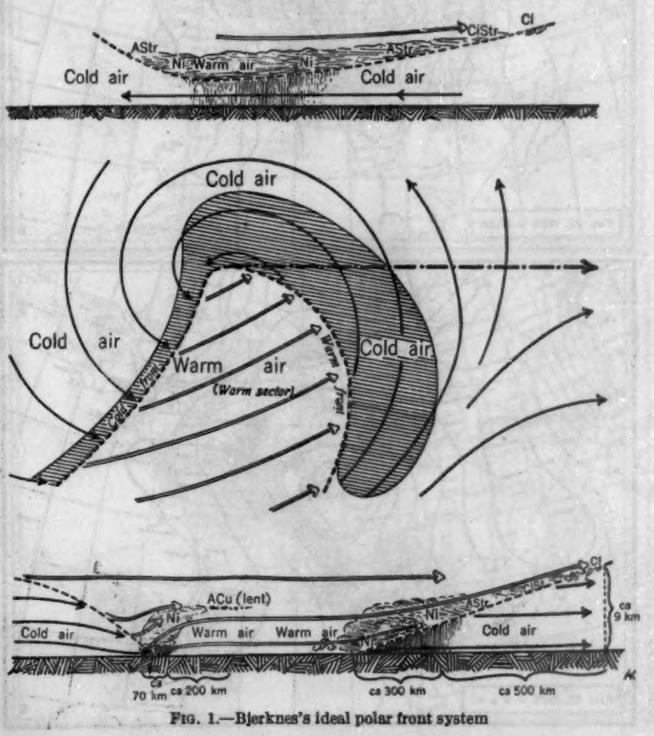


FIG. 1.—Bjerknes's ideal polar front system

south and southwest winds in the region of the cyclone and its trough, with cold air at the rear of the cyclone and also at its front. These air masses are separated by a fairly distinct boundary surface which passes through the center of the cyclone. This surface is inclined in the vertical always toward the cold side at an angle or slope of the order of from 1 to 50, up to 1 to 200, or a one-half of 1 per cent to a 2 per cent grade. The middle portion of figure 1 shows the plan of the surface air currents about a LOW.

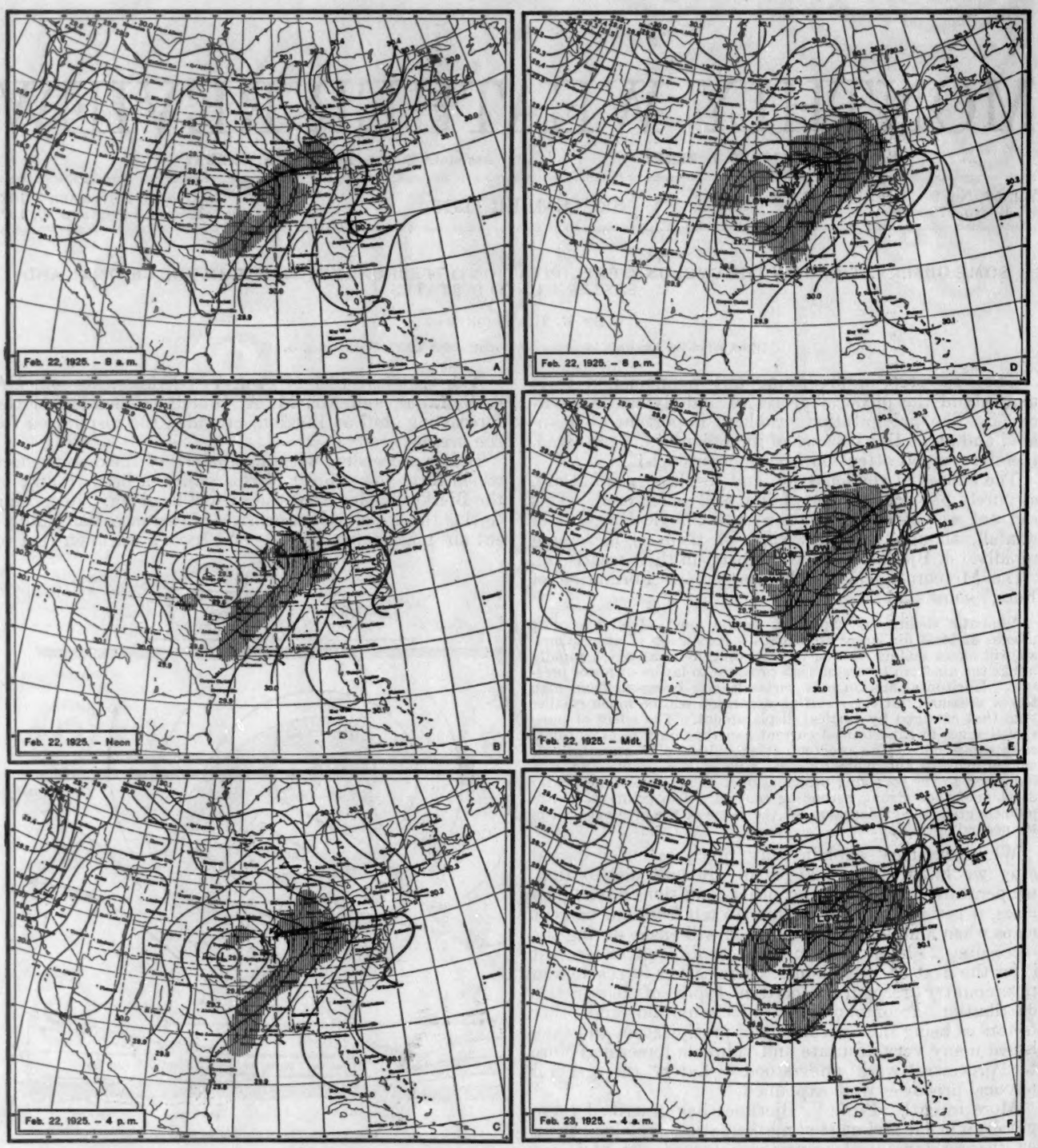


FIG. 2.—Weather maps of 8 a. m, February 22 to 8 p. m. February 23, 1925, with tracks of centers, and Bjerknes's diagram of secondary formation on cold front of the "Mother cyclone."

At the center of the LOW the warm and cold fronts meet. The upper portion of the figure shows a vertical east-west section through the cyclone north of the center. Here the air at the surface is from an easterly quarter, as we would expect in the northern quadrants of the LOW. Aloft the wind is from a southerly quarter and, being of equatorial origin, is relatively warm. It came originally from lower levels and lower latitudes, having undergone a forced ascent over the cold surface air with the result that there is considerable cloudiness and precipitation. The lower cut shows a vertical east-west section through the cyclone south of the center. At the left are seen the cold polar surface winds from the west and northwest underrunning the warm equatorial south and southwest winds, which latter persist aloft after the wind has changed to westerly at the surface. This

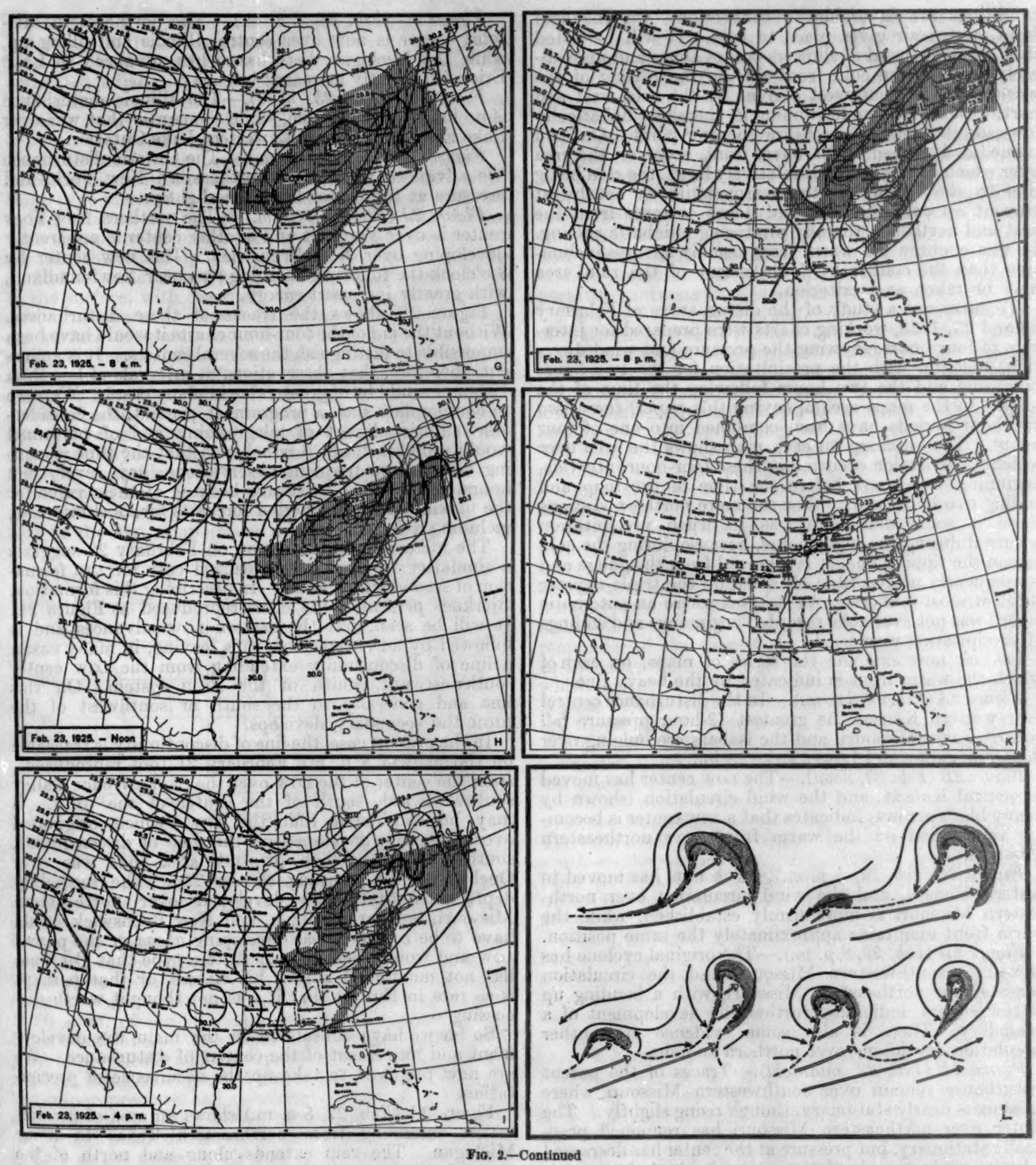


FIG. 2.—Continued

underrunning results in a forced ascent of the warm air from the south, with resulting cloudiness and heavy and, as a rule, brief showers. This front is called the "cold front," and is identical with the squall line or trough. At the right we have the relatively warm southwest winds overrunning the colder air to the east, giving rather widespread cloudiness and showers. In the central figure the broken line trending east and southeast from the LOW center shows the position of the warm front, while the cold front extends southwest from the center of lowest pressure. Hence, with the passing of the warm front, cold air at the surface gives place to warm. Between the warm and cold fronts, at and near which cloudiness and precipitation are in evidence, there is a region of warm air and relatively clear sky and sunshine, although cumulus clouds are to be expected because

conditions are favorable to convection. On the cold front, warm air gives place to cold. It will be noted that a narrow band of showers occurs along and immediately west of the cold front due to the raising of the warm south or southwest current by the cold west and northwest current underrunning it, thereby adiabatically lowering its temperature below the dew point. On, and immediately ahead of the warm front, however, the area over which rain is falling is relatively large, the rain being due to the forcing of the warm south or southwest current up over the cold and dense currents from the east and northeast, thereby producing adiabatic cooling. In this country the warm front usually has less inclination than the cold front if the extent of the rain area may be taken as a criterion.

To carry out a study of the disturbances of February 22 and 23, 1925, working charts were prepared for intervals of four hours, showing the pressure and wind direction, together with the precipitation for the two hours preceding and the two hours following the time of the map. In the maps accompanying this paper, these two two-hour periods have been combined into one of four hours. The hatching on each map shows the area over which precipitation occurred in these four-hour intervals, beginning two hours before the time of the map and ending two hours after. For the more northern stations there is some uncertainty as to when precipitation occurred during the night hours, because during the cold season the tipping bucket is removed from the gauge and consequently no record is obtained on the triple register sheet at most stations. At stations where an automatic record was not available, recorded beginnings and endings of precipitation were used.

Let us now examine the series of maps, on each of which the warm front is indicated by the heavy line.

Figure 2A (Feb. 22, 8 a. m.).—In the disturbance central over western Kansas the greatest 12-hour pressure fall occurred over Missouri, and the isobars are bulging over the Ohio Valley and Lower Lake region.

Figure 2B (Feb. 22, noon).—The LOW center has moved to central Kansas, and the wind circulation (shown by heavy black arrows) indicates that a new center is becoming established on the warm front over northeastern Missouri.

Figure 2C (Feb. 22, 4 p. m.).—The LOW has moved to eastern Kansas, and the wind circulation over northeastern Missouri is more firmly established, while the warm front maintains approximately the same position.

Figure 2D (Feb. 22, 8 p. m.).—The original cyclone has moved to southwestern Missouri, and the circulation persists over northeastern Missouri, with a bending up of the isobars, indicating further the development of a secondary. There is also some evidence of another circulation developing over northern Indiana.

Figure 2E (Feb. 22, midnight).—Traces of the parent disturbance remain over southwestern Missouri where pressure is nearly stationary, though rising slightly. The center over northeastern Missouri has remained practically stationary, but pressure at the center has decreased a little, while the circulation over northern Indiana is more truly cyclonic in character and pressure had fallen slightly.

Figure 2F (Feb. 23, 4 a. m.).—The parent center has practically lost its identity, and the northeastern Missouri disturbance remains nearly stationary, while the one that was over northern Indiana has moved to extreme southeastern lower Michigan. Pressure has fallen at both centers.

Figure 2G (Feb. 23, 8 a. m.).—The northeastern Missouri center is now over central Illinois and filling up, while the Michigan disturbance has advanced to Lake Erie with slightly increased intensity.

Figure 2H (Feb. 23, noon).—The Illinois disturbance is no longer recognizable, while the center that was over Lake Erie has advanced to western Lake Ontario.

Figure 2I (Feb. 23, 4 p. m.).—The Ontario disturbance has advanced to extreme northeastern New York, and pressure at the center has risen slightly.

Figure 2J (Feb. 23, 8 p. m.).—The northern New York center is over Vermont and another center is apparently developing over New Brunswick. This new center by 8 o'clock the following morning was near Newfoundland, with greatly increased energy.

Figure 2K shows the tracks of these disturbances. Without the aid of the four-hour charts it would have been impossible to distinguish the several centers. It is apparent, therefore, that observations at intervals of less than 12 hours would be of great value in many cases. Were we to contemplate such a program at present, the considerable additional cost of telegraphing and of personnel would prohibit it, but it is believed that the time is coming when more frequent observations, say, every six hours, will become necessary because of their value for the making of shorter period forecasts for local interests, including aviation.

The meteorological situation on February 22 suggests a similarity to Bjerknes's idealized case for the formation of secondary cyclones. In describing this formation, Bjerknes presented the chart reproduced as Figure 2L. It will be seen that the eastern LOW advances and is followed by an anticyclone, thus leaving, in many cases, a line of discontinuity extending from the LOW center southwestward, south of the HIGH system. On this line and generally to the south or southwest of the HIGH the secondary develops.

In the present case, the line of discontinuity is traceable on the map of 8 p. m., February 21 (not reproduced), from the center of the LOW over the St. Lawrence Valley southwestward, south of the center of the HIGH. It may be considered that the LOW, which originated over Colorado, developed on this line of discontinuity, southwest of the high pressure area that was over Quebec on the morning of the 22d. The secondary depressions that later developed over northeastern Missouri, northern Indiana, and New Brunswick would have to be considered as developing *ahead of* the parent LOW and would seem to constitute a type that Bjerknes has not mentioned among his classes, or that perhaps is so rare in Europe that it was not thought worth discussing

So far we have considered in the main the development and movement of the centers of disturbance We are now prepared to take up the occurrence of precipitation.

Figure 2A (Feb. 22, 8 a. m.) shows an area of precipitation extending from northeastern Texas to lower Michigan. The rain extends along and north of the warm front from northeastern Missouri northeastward to lower Michigan. This precipitation is of the warm-front type, as we have relatively cold east and northeast surface winds, while aloft, as shown by observations at Royal Center, Ind., we have southwest winds at 2,500 meters, the highest elevation reached by the kites. In other words, warm air is forced to rise over the cold wedge at the surface. This is further confirmed by the temperatures shown by the morning kite flight at Royal

Center, which indicate practically no change with elevation up to 1,100 meters and a lapse rate above that level of about 0.56° C. per 100 meters, or nearly the saturated adiabatic at temperature 0° C.

The showers which are in progress over the area extending from southern Indiana to northeastern Texas, between the warm front and the trough which generally marks the cold front, occurred in a great many instances in connection with thunderstorms. They are of the cold-front type mentioned by Bjerknes and Solberg in *Geofysiske Publikationer*, III, No. 1, page 8, Figure 4b. In this type the colder air in the rear of the trough does not undermine the relatively warm air at the surface, but comes in first at some higher level and gradually works down to the surface, with the result that there is, temporarily, cold air over warm. Immediately preceding these showers surface temperatures were 20° or more above the seasonal average. East of this main rain area instability showers under quite different circumstances are in evidence at Meridian, Miss. This type occurs, when humidity conditions are propitious, in air of polar origin, the upper portion of which remains relatively cold, while the lower layers warm up under clear skies until the resulting unstable equilibrium produces local showers.

Returning now to the main shower area, the free-air data at Groesbeck, Tex. (see fig. 3), show that from the 20th to the 21st temperature rose from the surface up to

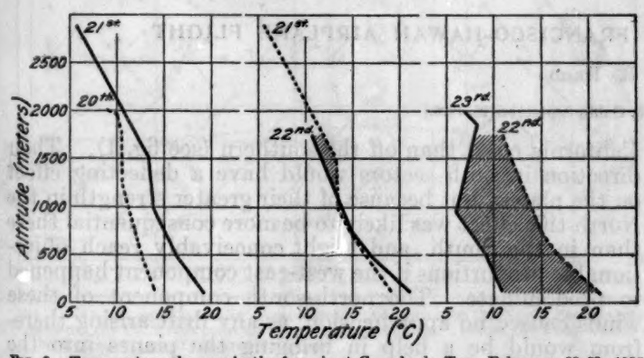


FIG. 3.—Temperature changes in the free air at Groesbeck, Tex., February 20-23, 1925 (shading shows temperature decrease between indicated dates)

2,000 meters and probably fell above that level, the latter point, however, being more or less speculative, owing to the fact that the flight of the 20th did not reach more than 2,000 meters. Comparing the 21st and 22d, it is seen that temperatures fell in the upper levels down to 750 meters, while below they had further increased. Showers occurred at intervals between 7:18 a. m. and 11:30 a. m. of the 22d. By the 23d temperatures had fallen at all levels. The vapor pressure on the 22d shows a rise at practically all levels up to 1,750 meters, the highest reached, being most marked above 1,000 meters. By the 23d vapor pressure had decreased greatly at all levels, indicating that all air above the station was of anticyclonic and polar origin. The lower temperatures came in first at the upper levels and at the same time as the winds in these levels shifted from south to southwest, the air of lower temperature apparently having had its origin in the anticyclone over the southern plateau. These temperatures and vapor-pressure conditions, together with the fact that the area of showers moved eastward in a narrow belt that was consistently covered by precipitation, would certainly indicate that the type of precipitation which prevailed was of the cold-front type described above. Further, there is every reason to suppose from all the facts available that the sequence of conditions experienced at Groesbeck was progressively experienced at stations to the eastward. Unfortunately no kite data are available for Due West, S. C., on the 22d and 23d, due to an enforced curtailment of the observational program.

Figure 2B (*Feb. 22, noon*) shows a rain area very similar to that of the 8 a. m. map. The first indication of a second area of cold-front rain is the light shower at Amarillo. Such light showers are typical of cold fronts along the eastern slope of the Rocky Mountains, because the winds attending them have a down-slope direction, and consequently a tendency to be warmed through increased pressure; hence it is only in cases of decided temperature contrasts that precipitation ensues.

Figure 2C (*Feb. 22, 4 p. m.*).—There are now two areas of warm-front rains, the first over northeastern Kansas and northwestern Missouri, associated with the principal LOW center over eastern Kansas, and the second extending along and north of the warm front from Illinois to lower Michigan and northern Ohio, associated with the new LOW center developing over northeastern Missouri. The belt of showers extending from Indiana to Texas maintains the same position relative to the LOW center.

Figure 2D (*Feb. 22, 8 p. m.*).—Warm-front rain extends along and north of the warm front from northern Illinois to western New York and the area of cold-front showers maintains the same position relative to the new LOW center, but has advanced slightly eastward. The secondary area of cold-front rain is in evidence over Kansas, northwestern Missouri, and southeastern Nebraska, although the rain in the last-named State is possibly a remainder of the warm-front rain of the preceding map, as indicated by the temperature trace sheet at Drexel, which shows a characteristic warm-front form. The Kansas rain is clearly of the cold-front type, as shown by the thermograph traces of the several stations.

Figure 2E (*Feb. 22–23, midnight*).—Warm-front rain in connection with the northeastern Missouri disturbance has ceased, probably due to the failure of the south or southwest warm current, but is spreading in connection with the new center developing over northern Indiana. The cold-front showers continue and extend from Ohio south-southwestward to the northwest portion of the East Gulf States, having advanced slightly eastward, while the secondary area of cold-front rain covers Missouri.

Figure 2F (*Feb. 23, 4 a. m.*).—Warm-front rain continues to spread eastward from the new LOW center over southeastern lower Michigan, and has reached western New England. The cold-front showers continue in a narrow band from Ohio and western Pennsylvania to the Middle Gulf States and also over Indiana and northeastern Kentucky. The secondary cold-front rain area has increased in size and extends from southern Lake Michigan to Missouri, the Chicago thermograph trace showing the advent of the cold front at that station about midnight.

Figure 2G (*Feb. 23, 8 a. m.*).—Shows the warm-front rain covering New England, while the belt of cold-front showers has advanced slowly eastward. Rain still continues over northern Indiana, southern Illinois, and Ohio. The *secondary* cold front rains are fairly continuous along and immediately in the rear of the cold front, and are confined to the area formerly occupied by the depressions. Such regions are, of course, the most active as far as temperature changes are concerned and are generally the regions of greatest pressure change.

Figure 2H (Feb. 23, noon).—Shows much the same distribution of precipitation as the preceding one, except that showers have temporarily ceased in southern Georgia. The whole system is advancing slowly eastward.

Figure 2I (Feb. 23, 4 p. m.).—Shows clearly the difference in the position of the warm-front rain and the two areas of cold-front showers; these areas are separate and distinct.

Figure 2J (Feb. 23, 8 p. m.).—Shows the same general conditions as the preceding figure, except that the whole system has advanced slowly eastward.

This study serves to give an insight into the several types of rainfall associated with the polar front theory, which, in this case, shows a quite orderly behavior. It should be remembered, however, that these LOWS showed remarkably small changes at the centers, the lowest pressure varying between 29.48 and 29.58 inches, not considering the diurnal variation. Further, they had a regularity of movement both with respect to direction and rate that is not usually encountered. The major currents associated with them were uniform and well established. Under such circumstances, forecasting is is not the trying task it sometimes is.

In cases where the movement is rapid, where the barometric changes at the center are marked, or where there is irregularity of direction and rate of movement, well-ordered rain areas are not the rule, and in such cases we have, of necessity, to depend on our ability to forecast the erratic behavior of the LOWS.

The Bjerknes system is used exclusively in Norway and to a considerable extent in the British Isles and other European countries. Since this system has proved so useful in Europe, it behooves us in the United States to study its newer features carefully in order that we may not overlook an opportunity of improving in any way our forecasting methods. Our problem is somewhat different from that of the European meteorologists, as shown by the following statement in the paper of J. Bjerknes and H. Solberg: "Life Cycle of Cyclones and the Polar Front Theory":

> A very large percentage of European cyclones are occluded ones, being dying remainders of previously strong Atlantic depressions. The predominance of occluded cyclones in Europe has led to the statistical result that cyclones usually have a cold core.

In the United States about 40 per cent of all disturbances that affect us develop within the continental confines or along the Atlantic or Gulf coasts. They are, therefore, new or increasing disturbances as distinguished from the dying or occluded cyclones of Europe. On this account it would seem that in this country we must continue to rely in the main on our established methods, with such improvement as can be made on them.

METEOROLOGICAL ASPECTS OF THE SAN FRANCISCO-HAWAII AIRPLANE FLIGHT

By THOMAS R. REED

[Weather Bureau, San Francisco, Calif., September 28, 1926.]

The nonstop flight essayed by naval airplanes from San Francisco to the Hawaiian Islands, August 31 to September 1, 1925, attracted nation-wide attention as being the longest nonstop ocean flight that had yet been attempted. Almost as interesting as the fact of the flight itself are some of the details of organization by which it was hoped to insure the success of the project. None of these details was more important than the meteorological preparations. The plans in this regard were thorough in the extreme. It was recognized from the outset that success would largely hinge on the character of weather encountered, particular dependence being placed on the prevalence of trade winds which normally are found over the greater part of the course between the southern California coast and Honolulu. The extent, duration, and force of these winds therefore constituted the first problem to be considered, since they were to decide the date of departure and the point on the California coast from which the flight would start.

The choice of sites for the commencement of the flight lay between San Francisco and San Diego, the former being finally decided upon in conference between Commander John Rodgers and Lieut. Allen T. Snody and the local officials of the Weather Bureau in San Francisco. San Diego, although farther from Hawaii in actual distance than San Francisco, nevertheless had a strong claim. Being some 5° nearer the Equator, San Diego is situated in the latitude of the summer trade winds, and while these winds are not found in the proximity of the southern California coast, it was believed that the trade-wind belt would be sooner entered if the departure were made from the southern city. Furthermore, the winds which would intervene between the coast and the point at sea where the favoring trades were looked for were known to be normally more adverse off the northern California coast than off the southern (see fig. 1). Their direction in both sectors would have a deflecting effect on the planes, but because of their greater strength in the North this effect was likely to be more consequential there than in the South, and might conceivably reach objectionable proportions if the west-east component happened to predominate. The north-south component of these winds caused no apprehension, as any drift arising therefrom would be a help in bringing the planes into the southern latitudes occupied by the northeast trades.

But whatever disadvantages were to be feared from possible west-east components of movement off the north and central coast were more than offset by the counterclaims of shorter mileage from San Francisco and the reasonable certainty of favorable local conditions for taking off. Due to the great fuel load, it was considered desirable that the planes should take off against a wind of at least 15 miles per hour. Another requisite was an adequate stretch of shallow water; the planes must have ample space in which to gain flying speed, and launching has been found to be most readily effected in very shallow water. Ideal conditions in these respects exist along the western shores of San Pablo Bay (as the northern reaches of San Francisco Bay are known), and this site was finally decided upon as the point of departure. Satisfactory test flights under full load were made there before the day of departure. On the final day both planes got off easily and within a few minutes of each other.

The next question to be considered was the date on which the flight should be attempted. Pressure was exerted to have it coincide with the opening of the Diamond Jubilee festival to be held in San Francisco beginning on September 5. Examination of data, however, led to the conviction that the most favorable winds, both locally and in the trade-wind belt would be found

in August. The first attempt did not actually take place, however, until August 31, as it proved impracticable to put the machines in mechanical trim for the flight before that date, and then only the two planes of the *PN–9* type were ready. The *PB–1* plane was found to require still further adjustments and therefore remained behind.

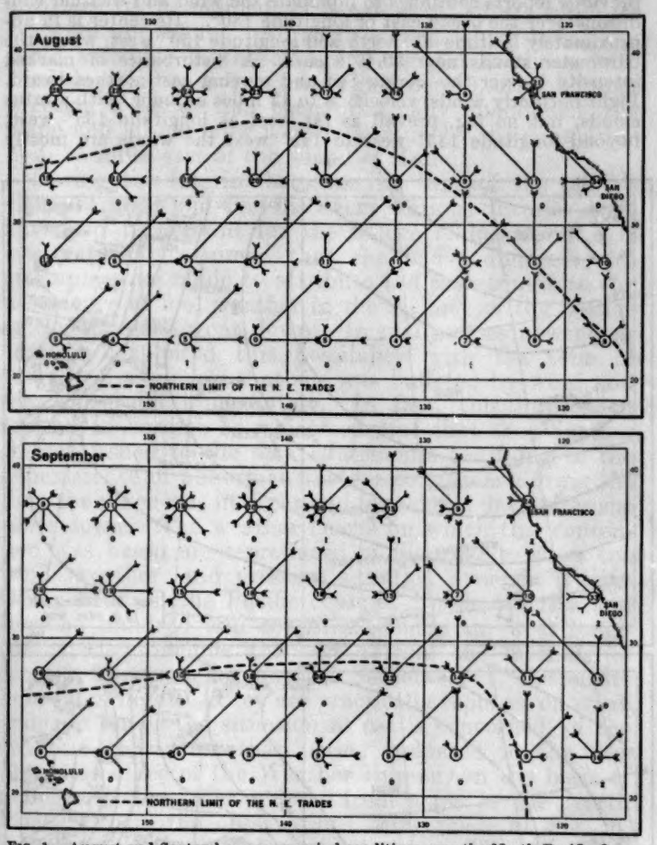


FIG. 1.—August and September average wind conditions over the North Pacific Ocean between the California coast and the Hawaiian Islands. (From the Pilot Charts of the United States Hydrographic Office)

Plans were initiated early in the summer looking toward the issuance of special weather forecasts and bulletins. The following quotations from a letter from the aerological officer on the U. S. S. *Langley* indicate the character of cooperation which was expected of the Weather Bureau, and outline with admirable clarity the organization which the Navy was undertaking to provide for the furtherance of the meteorological program:

The general aerological plan is as follows: There will be ships stationed about every 200 miles from either San Diego or San Francisco (depending upon which place the flight starts, which is to be decided later) to Hawaii. There will be a competent aerological detail on the vessel stationed 600 miles from San Diego or San Francisco; one on the *Langley*, stationed 1,200 miles from San Diego or San Francisco; and one on the *Aroostook*, stationed 1,800 miles from San Diego or San Francisco.

At the base station (San Diego or San Francisco) there will be an aerological unit in charge of Lieutenant Wyatt, which unit will maintain a weather map and issue all aerological information upon which the flight will be based.

The naval air station, Pearl Harbor, Hawaii, and the *Langley*, *Aroostook*, and ship stationed 600 miles from the base station will obtain the following data at 9:15 a. m. and 7:30 p. m. (one hundred and twentieth meridian time) and transmit same promptly to commander flight project at NPL or NPG[1]:

1. Time of observation (one hundred and twentieth meridian time).
2. Barometer.
3. Pressure change preceding two hours, if 0.10 inch or more.
4. Wind velocity and direction at surface and from soundings aloft.
5. Condition of sea.
6. Clouds and their direction.
7. Fog and its direction.
8. Local conditions "are" or "are not" favorable for flight.

After start of flight all aerological reports will be discontinued unless local conditions become or tend to become unsuitable for flying, in which event a brief dispatch will be sent to commander flight project and to station ships nearest the planes for relay to them.

These data will be forwarded by Pearl Harbor, beginning August 26, 1925, and by designated ships after taking assigned stations midnight August 27–28.

The base aerological unit (commander flight project) will use these data for correcting weather maps.

These stations have been directed to send to Weather Bureau, San Francisco, the routine weather reports required from vessels at sea, namely, reports at 7 a. m. and 7 p. m., seventy-fifth meridian time, or 4 a. m. and 4 p. m., one hundred and twentieth meridian time.

We would appreciate it if you would transmit to base aerological unit via NPG a special forecast covering the area between starting point and Honolulu. This information is desired from August 26 until the completion of the flight.

Will you please take up this matter of ships' reports with the various steamship companies and request that they have as many vessels as possible make all regular reports from August 26 until completion of the flight so that you can have as much data as possible in making your forecast? Let me know if there is anything we can do along that line to help.

Do you want all our ships to send the routine reports in addition to the three ships having aerological units on board? I think it will be best to do so.

It is requested that you send commander flight project via NPG all available a. m. and p. m. ship reports.

You can communicate with the commander aircraft squadrons and later with commander flight project at any time at no cost to the Weather Bureau through the commandant twelfth naval district.

Any assistance you can render to the base unit will be appreciated.

The program thus set forth was carried out without material change. Although nearly all steamships plying trans-Pacific routes, with the exception of the Japanese, were already cooperating with the Weather Bureau by rendering daily radiographic weather reports, the urgency of such reports for the period of the flight was emphasized by the broadcast of special notices from radio station NPG, asking for the fullest cooperation in the dispatch of such messages during that time. The response was cordial, and enough data were collected to construct quite complete weather charts of the northeastern Pacific Ocean on the critical days (see fig. 2).

The problem of liaison between the Weather Bureau and the flight-project officers was next considered. Choice of several locations for the establishment of meteorological headquarters was offered. One was in the building in which is located the naval radio station NPG, where many radiographic weather reports destined for the Weather Bureau are received. These, together with information intended specially for the flight project, would be instantly available to the naval meteorologists if headquarters were there. Another site was Crissy Field. Here the flight project was based; and as a result, contact with project officers and pilots would be most direct. The Weather Bureau office in San Francisco offered the third and finally selected choice, decision having been left to the naval aerologist of the San Diego Naval Air Station, who was in charge of meteorological preparations. He conducted all his operations from this office. By so doing full use was made of Weather Bureau facilities, and the necessity of preparing independent synoptic charts was obviated. Frequent consultation with the forecast officials there was also easy, and this worked to the mutual advantage of both the Navy and the Weather Bureau, as the latter was thereby in intimate touch with

[1] The naval radio station at San Francisco is designated by the call letters NPG.

the needs of the former, while the Navy meteorologists could draw on the special knowledge and experience of the Weather Bureau officials for advice on which to base their decisions.

Two special bulletins were issued by the Weather Bureau for the information of the flight project officials, one on the day of the flight and one on the day preceding. The following is the bulletin issued on August 30 and before the flight:

AUGUST 30, 1925.

Meteorological situation over the northeastern Pacific Ocean and the outlook for wind and weather over the route from San Francisco to the Hawaiian Islands.

The bulletin on the day of the flight reads as follows:

AUGUST 31, 1925.

Meteorological situation over the Pacific Ocean and the outlook for wind and weather over the flying route from San Francisco to the Hawaiian Islands.

Situation to-day.—The area of high barometer referred to in previous reports continues to dominate the wind and weather conditions over the ocean east of longitude 180°. Its center is in approximately latitude 40° north and longitude 150° west, where the barometer stands near 30.40 inches. A disturbance of marked intensity is over the Bering Sea and moving east-northeastward. Light northerly winds, velocity 8 to 12 miles an hour, with stratus clouds, but no fog, prevail as far west as longitude 135° west; beyond longitude 135° west to 145° west the winds are mostly

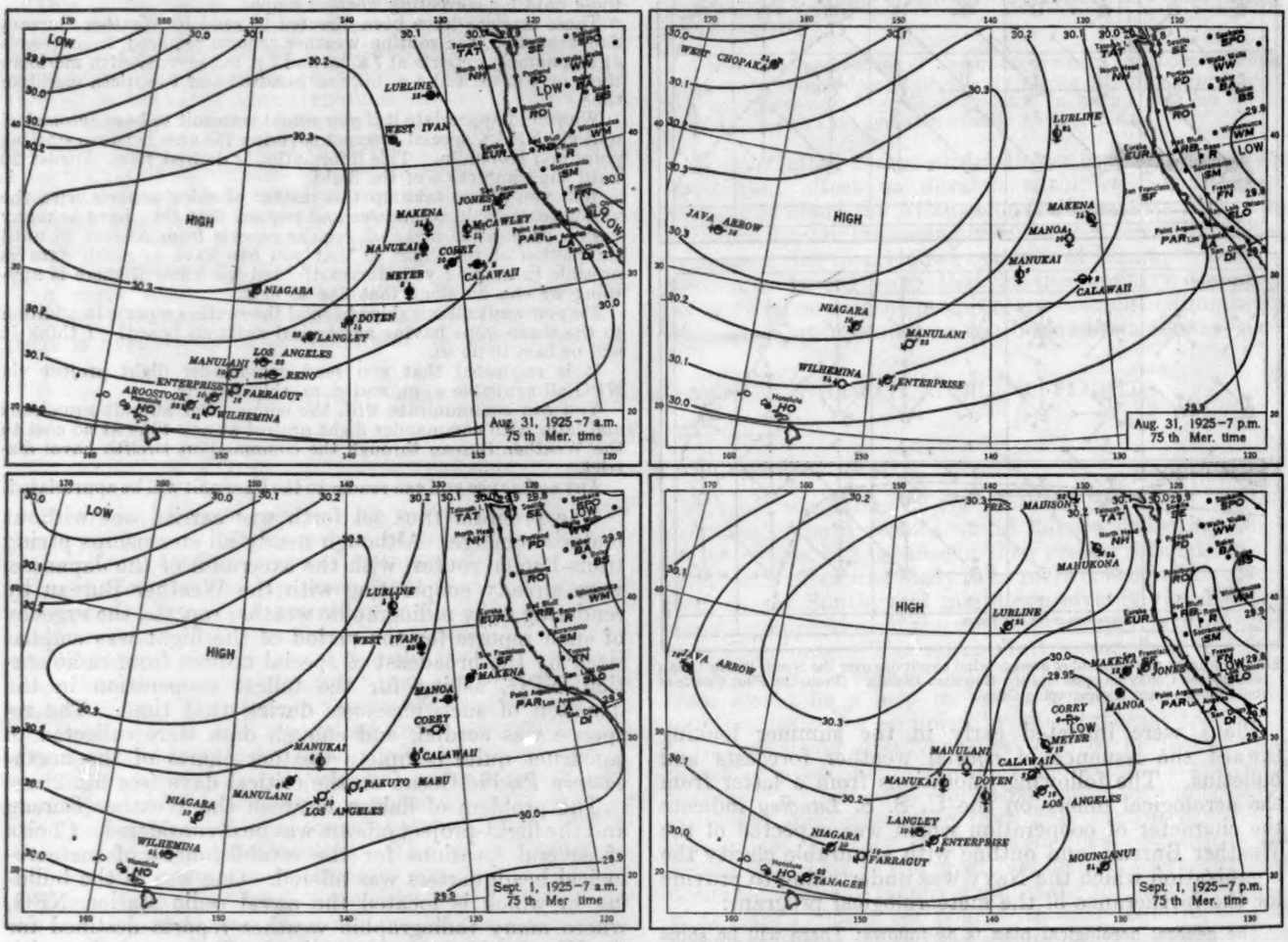


FIG. 2—Weather conditions along the route of the San Francisco-Hawaii flight, August 31 and September 1, 1925

Situation.—The barometer stands high generally over the ocean south of latitude 50°, with the center of maximum pressure in approximately latitude 40° and west longitude 145°, where the pressure is near 30.40 inches. Low barometric pressure prevails to the northward of latitude 50°, and a disturbance of considerable intensity has its center near Dutch Harbor, Unalaska, whence it will move eastward. The weather is overcast, with light northerly winds, not more than 10 miles an hour, from the California coast westward to longitude 130°; beyond 130° the winds are northeast, 10 to 18 miles an hour, and the sky partly overcast, as far as longitude 145°; beyond 145° to and including the vicinity of the Hawaiian Islands, the sky is partly overcast with strato-cumulus clouds and the winds are east, 15 to 20 miles an hour.

Outlook.—The indications are that the pressure situation as described under "Situation" will undergo little change within the next 36 hours, and that the wind and weather will be favorable along the route from San Francisco to the Hawaiian Islands for the start of the flight Monday.

northeast, 10 to 20 miles an hour, and the sky overcast with strato-cumulus clouds; beyond longitude 145° west to and including the vicinity of the Hawaiian Islands, the winds are east and northeast and from 15 to 24 miles an hour and the sky generally clear. No fog reported along entire route; ceiling 1,000 feet or above.

Outlook.—The indications point strongly to a continuance of the prevailing pressure situation and current wind and weather conditions along the flying route during the next 36 to 48 hours. *The conditions are exceptionally favorable for the start of the flight.*

The situation along the flying route approximated very closely what was predicted, a fact particularly gratifying to all concerned in view of the enforced descent of both planes in the open sea and the extraordinary hazard which would have resulted had the weather become stormy during or after the period of the flight. Lieutenant Snody was brought down by mechanical difficulties

when about 300 miles from San Francisco. He was promptly picked up. Commander Rodgers was less fortunate. When approaching the Hawaiian Islands, after some 1,800 miles of flight, his gas supply gave out and he was compelled to land. Although the plane was in communication by radio with the patrol ship *Aroostook* until nearly the moment of her descent, efforts to locate her were unavailing. All surface craft which the Navy could assemble in those waters engaged in the search. Nine days later, at 4 p. m., September 10, after hope of effecting a rescue had been practically abandoned, the plane and all her crew were picked up by the submarine *R–4*, 15 miles east of the island of Kauai.

During the interim between the time of the plane's disappearance and her discovery various theories were advanced to account for the failure to locate her. It was naturally assumed that she had foundered, and attempts were made to attribute the catastrophe to the prevalence of foul weather in the vicinity of the islands at the time she went down. In many cases newspaper accounts exploited this possibility with the tone of assurance, assuming that she was buffeted by wind and sea, and sank immediately. In fact, this impression seemed to become so widely current that the Weather Bureau issued to the press statements testifying to the nonexistence of abnormal weather conditions during the time the plane was in flight and for several days after she came down. The weather charts on which this contention was based are reproduced in Figure 2 to show the wind, weather, and pressure situation over the Pacific Ocean between the Pacific coast of North America and the one hundred and seventieth meridian, west longitude. They include the period from the morning of August 31 to the evening of September 1, the entire interval of flight. They are practically replicas, on small scale, so far as the situation at sea is concerned, of the synoptic charts for that period prepared in the San Francisco office of the Weather Bureau, on the basis of radiographic weather reports from ships in the North Pacific Ocean, the observations being made at 7 a. m. and 7 p. m., seventy-fifth meridian time. These observations do not, it will be observed, imply the existence of abnormal weather conditions in the area of the Hawaiian Islands at any time during the period.

The symbols employed are the usual ones to indicate wind direction and state of weather. An unfilled circle indicates clear weather at the time of observation, a half-filled circle partly cloudy weather, and a filled circle cloudy weather. Arrows fly in the direction in which the wind is reported as blowing. The velocity of the wind as estimated by the observer is given in miles per hour at the point of the arrow. Where no arrow is shown the weather is understood to be calm.

While the concluding chart of the series, that for the evening of September 1, indicates a moderate depression some distance off the southern California coast, conditions everywhere west of longitude 145° are of the type that might be expected to prevail there over the greater part of the summer. Cloudiness is neither extensive nor of an unusual character, while winds as regards both direction and force are normal.

The evening report from the U. S. S. *Langley* on September 1 incorporated the following additional data, obtained from pilot balloon observations, exhibiting the movement of the wind aloft:

Altitude (feet)	Wind direction	Velocity, miles per hour
Surface.	NE	10
1,000	NE	16
2,000	NE	13
3,000	NE	12
4,000	NE	12

The *Langley's* position, in approximately latitude 26° N., longitude 146° W., while not close to the point at which Commander Rodgers was forced down, was nevertheless not so remote as to render free-air data inapplicable, and her observations serve to confirm the inferences drawn from surface data throughout the area as to the nonexistence of any abnormal tendencies either local or widespread west of longitude 145°.

It is a pleasure to record the cordiality of cooperation between the Weather Bureau and the Navy Department in the transactions incident to the west coast-Hawaiian flight. The following letter to the official in charge at the San Francisco office of the Weather Bureau from Capt. Stanford E. Moses, United States Navy, commander, aircraft squadrons, Battle Fleet, who was designated to act as project commander for the flight, bears significant testimony thereto:

> I want to thank you and your assistants at the Weather Bureau for their kindness and splendid cooperation with us in connection with the west coast-Hawaiian seaplane flight.
>
> Your work was excellent and your long knowledge of weather conditions was of great help to us.

A FURTHER STUDY OF THE RELATION BETWEEN COVER CROPS AND ORCHARD TEMPERATURES

By FLOYD D. YOUNG

[Weather Bureau office, Los Angeles, Calif., September 29, 1925]

For a number of years many citrus growers in southern California have believed that the presence of a cover crop in an orchard lowers the temperature several degrees on a frosty night. As a result, the growing of winter cover crops has been abandoned in many citrus groves where this practice is quite necessary to maintain the fertility of the soil. Shortage of irrigation water prevents the growing of summer cover crops in most districts.

The Weather Bureau carried on experimental work at Pomona during the winter of 1921–22, to determine just what influence a cover crop has on the temperature on frosty nights. A complete report on this work was published in the MONTHLY WEATHER REVIEW.[1]

It was found that the air temperature was depressed only 0.1° F. at a height of 5 feet above the ground, and 1.0° F. at a height of 10 inches above the ground, due to the presence of a cover crop. Since there usually is little fruit near the ground, the temperature differences found should have little effect on the amount of damage to the fruit.

Observations made with unsheltered thermometers, at heights of 24 inches and 7 inches, respectively, showed that the minimum temperature was lowered 0.4° F. at the 24-inch elevation and 2.4° F. at the 7-inch elevation, due to the presence of the cover crop. Temporary temperature differences in the earlier part of the night as great as 8.7° F. at the 24-inch elevation, and 11.0° F. at the 7-inch elevation, were observed. These large differences

[1] Young, Floyd D.: Influence of Cover Crops on Orchard Temperatures. MONTHLY WEATHER REVIEW, October, 1922, 50 : 521–525.

were thought to be due to wind, which mixed the colder surface air strata with the warmer strata at slightly higher levels, the effect reaching down to the ground in the clean cultivated area, but not penetrating much below the tops of the cover crop plants because the cover crop acted as a windbreak on a small scale. During the entire period covered by the experiment the ground in the orchard was very damp, and often was wet and muddy. The area of the orchard used in the 1922 experiment was only 6 acres. It was thought that a larger area in cover crops might lower the temperature to a greater degree.

During the fall of 1923, a 10-acre orange grove near Claremont, Calif., was selected for the continuation of the experiment. The grove selected was almost ideally located for the test. It was practically level, with mature Navel and Valencia orange trees set 20 feet apart, on the square. The cover crop consisted of purple vetch, planted 40 pounds to the acre, a heavy volunteer crop of Broad Windsor horse beans, and many high weeds. The soil was a rich black loam. The grove was kept well irrigated, and the cover crop made a luxuriant growth. The entire grove was in cover crop when the experiment was begun. The rainfall during the winter was unusually light, and the ground in the orchard was dry during the greater part of the time, except immediately following irrigations.

The same plan of operation was followed in this experiment as in the former one at Pomona. The grove was divided into two 5-acre plots designated as "east" and "west" plot, respectively, and temperature stations were placed near the center of each.

The instrumental equipment and exposure of instruments were the same at both stations. (Fig. 1.) Fruit-region instrument shelters, containing maximum and minimum thermometers, and 29-hour thermographs were installed on supports so that the thermometers were 5 feet above the ground. Fruit-region shelters, containing the same instrumental equipment, were set directly on the ground, the thermometers being 10 inches above the ground.

After the stations had been established 10 clear, frosty nights were allowed to pass with the entire grove still in cover crop, in order to establish a definite temperature relation between the two plots. The minimum temperatures registered in both plots on these nights are given in Table 1. Temperatures averaged 0.1° F. lower at the 5-foot elevation and 0.2° F. lower at the 10-inch elevation in the west plot than in the east plot during this period.

East plot cover crop removed.—On January 4, 1924, the cover crop in the east plot was plowed under,[2] and the ground was cultivated so thoroughly that hardly a trace of the cover-crop plants remained on the surface of the ground. (See fig. 2.) The cover crop in the west plot was not disturbed. If the cover crop had been exerting a marked influence on the temperature, the east plot, now clean cultivated, should be considerably warmer than the west plot, still in cover crop.

After the cover crop in the east plot was removed temperature records were obtained covering 24 frosty nights. Minimum temperatures recorded at the two elevations in both plots each night during this period are shown in Table 2.

It will be noted that the average difference in minimum temperature between the two plots is only 0.6° at the 5-foot elevation and 1.5° at the 10-inch elevation. Comparing these differences with the average differences between the two plots before the cover crop was removed from the east plot, it will be seen that the cover crop lowered the minimum temperature 0.5° at the 5-foot elevation and 1.3° at the 10-inch elevation. We might assume from these figures that the temperature was lowered about 1° at a height of 3 feet above the ground. On a night when the temperature barely falls to the danger point in a clean cultivated grove this difference of 1° might account for considerably more damage to fruit in the lower portion of the trees in an orchard with a cover crop.

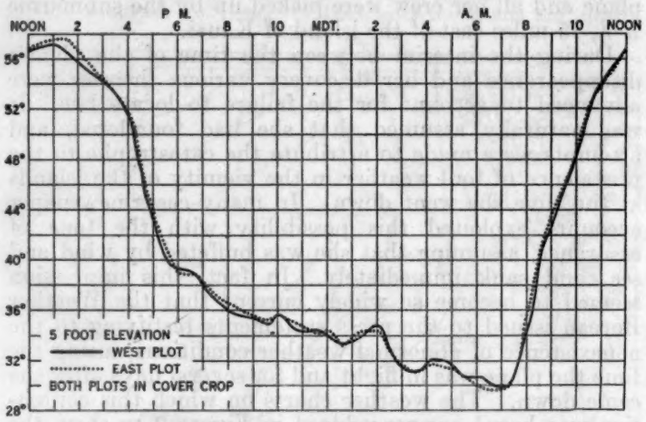


FIG. 3.—Average semihourly temperatures during eight clear, frosty nights, at east and west experimental plots, while the entire grove was still in cover crop. (Sheltered thermometers, 5 feet above the ground.) This figure shows the normal relation between the temperature in the two plots, and is to be used as a check for Figure 4

In order to have a complete record of the influence of the cover crop on the temperature throughout the day and night semihourly temperatures for the whole 24 hours on each of the 19 days on which frost occurred after the cover crop was removed from the east plot

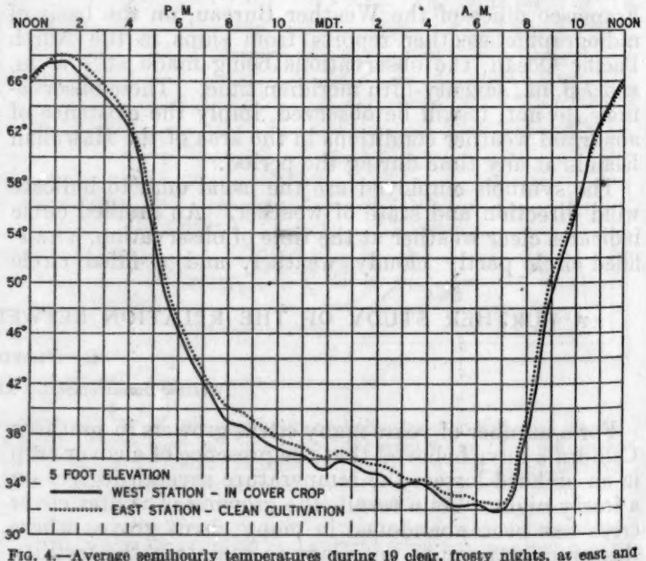


FIG. 4.—Average semihourly temperatures during 19 clear, frosty nights, at east and west experimental plots, after the cover crop in the east plot had been plowed under. The west plot is still in cover crop. (Sheltered thermometers, 5 feet above the ground.) A comparison between Figures 3 and 4 shows the effect of the cover crop on the temperature at this elevation

were averaged and plotted. The same data were secured for 8 days while both plots were in cover crop, to show the normal relation between the daily march in temperature at the two stations. As 29-hour thermographs were used, and the records were checked frequently on cold nights, both as to time and temperature, it was possible

[2] The writer wishes to express his appreciation for the action of the Ontario-Cucamonga Fruit Exchange and the Pomona Valley Orchard Protection Association in paying the expense of plowing under the cover crop in the 5-acre plot during the 1923-24 experiment.

(To face p. 388)

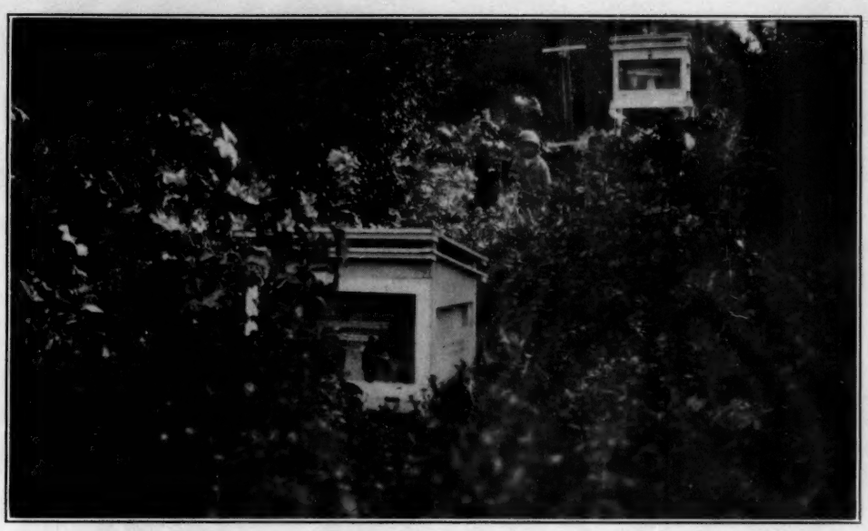


FIG. 1.—West experimental plot, showing instrument shelters and growth of cover crop. [The stand of cover crop on the east plot was so closely similar to that on the west that no view of it is presented]

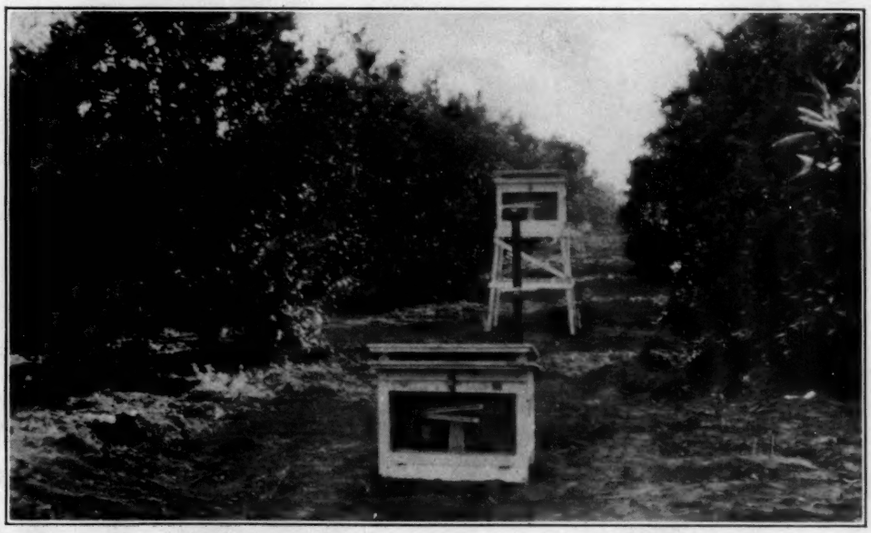


FIG. 2.—East experimental plot after removal of cover crop

to calculate these semihourly temperatures to tenths of a degree with considerable accuracy.

The average semihourly temperatures for the 5-foot shelters at the east and west stations during the period while the entire grove was still in cover crop are shown in Figure 3. The same data for the period after the cover crop had been removed from the east plot are shown in Figure 4. These diagrams show that the temperature was lowered about 0.5° F. at the 5-foot elevation throughout the period from 6 p. m. to 10 a. m.

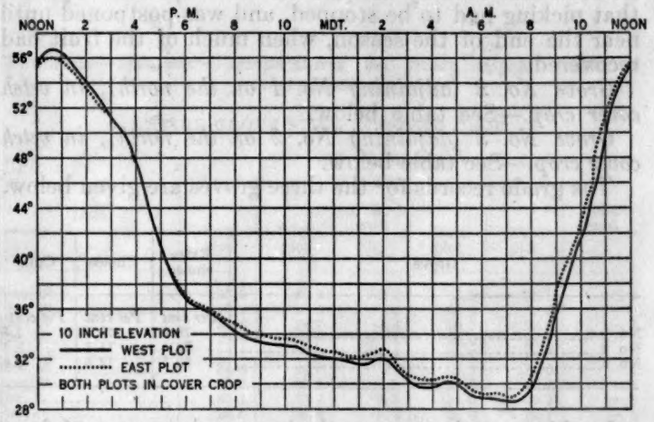


FIG. 5.—Average semihourly temperatures during eight clear, frosty nights, at east and west experimental plots, while the entire grove was still in cover crop. (Sheltered thermometers, 10 inches above the ground.) This figure shows the normal relation between the temperature in the two plots. This diagram is to be used as a check for Figure 6

The effect of the cover crop was considerably greater at the 10-inch elevation. A comparison of Figures 5 and 6, which show the difference in temperature at this elevation before and after the cover crop was removed

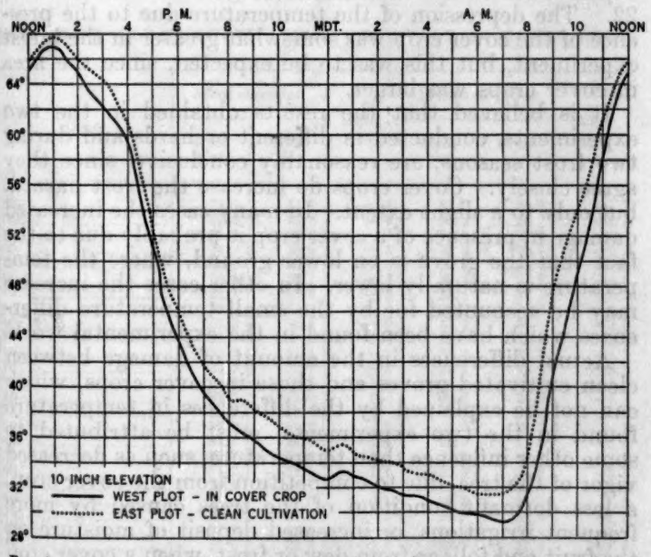


FIG. 6.—Average semihourly temperatures during 19 clear, frosty nights, at east and west experimental plots, after the cover crop in the east plot had been removed. The west plot is still in cover crop. (Sheltered thermometers, 10 inches above the ground.) A comparison between Figures 5 and 6 shows the effect of the cover crop on the temperature at this elevation

from the east plot, brings out this point. Figure 6 shows that the temperature in the cover-crop plot was lower than in the clean cultivated plot both day and night. The fall in temperature during the evening was earlier and the morning rise in temperature was delayed in the cover-crop plot. During the period from 6 p. m. to 8 a. m. the temperature in the cover-crop plot was depressed from 1° to 2°. During the period from 8 a. m. to 11 a. m., while the temperature was rising rapidly, the lag in the rise in temperature in the cover-crop plot was sometimes as much as 4°.

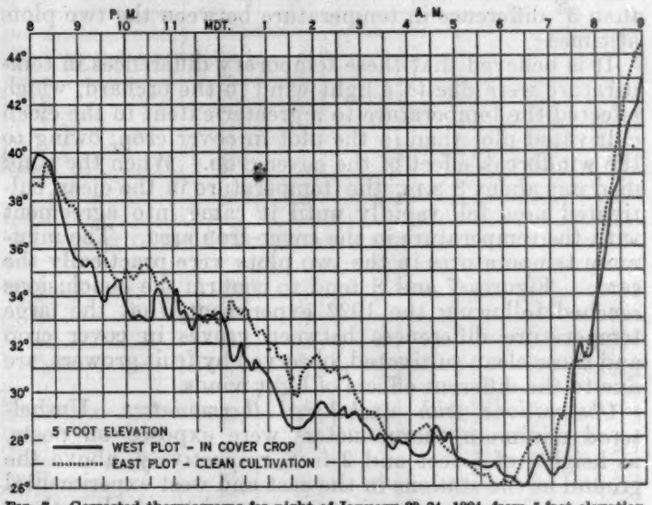


FIG. 7.—Corrected thermograms for night of January 23-24, 1924, from 5-foot elevation sheltered thermometers in east plot (clean cultivation) and west plot (in cover crop) showing effect of the cover crop on the temperature. See Figure 3 for normal relation between temperature in the two plots

In Figure 7 are shown corrected thermograms for the east and west 5-foot stations for the night of January 23–24, 1924, the coldest night which occurred after the cover crop was removed from the east plot. A comparison of Figure 7 with Figure 3 shows the effect of the cover crop on the temperature at the 5-foot level on this night.

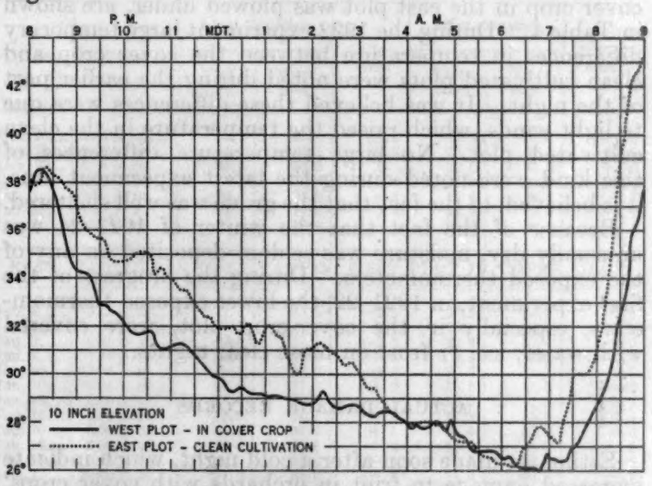


FIG. 8.—Corrected thermogram for night of January 23-24, 1924, from 10-inch elevation sheltered thermometers in east plot (clean cultivation) and west plot (in cover crop), showing effect of the cover crop on the temperature. See Figure 5 for normal relation between the temperatures in the two plots. From the character of the record it is evident that the lower temperature in the cover crop area during the earlier part of the night is due to the greater mixing effect of the wind in the clean cultivated plot

Corrected thermograms for the same night, January 23–24, at the 10-inch elevation in both the east and west plots, are shown in Figure 8. They should be compared with Figure 5, which shows the normal relation between the two plots while both were still in cover crop. Note the greater fluctuations in temperature in Figure 7 as compared with Figure 8, due to the mixing of the air

strata of different temperatures by light winds at the 5-foot elevation, which were not felt at the 10-inch elevation. The records for this night, both at the 5-foot and the 10-inch elevation, show an unusually large difference in temperature between the plot in cover crop and that in clean cultivation during the early part of the night. At the 10-inch elevation there was more than 3° difference in temperature between the two plots at times.

It is believed that these temporary differences in temperature were due to a light wind in the orchard, which affected the temperature to a greater extent in the clean cultivated plot than in the plot in cover crop, owing to the windbreak effect of the cover crop. When the wind died out about 3 a.m. the temperature in the clean cultivated area fell rapidly until it came into agreement with the temperature in the cover-crop area. The minimum temperatures in the two plots were practically the same. Figures 7 and 8 tend to confirm the conclusions reached following the 1922 experiment, that the large temperature differences between groves in cover crop and those clean cultivated, observed by fruit growers, are due to the different effects of light winds.

Observations with unsheltered thermometers.—Unsheltered minimum thermometers were exposed on posts, at heights of 5 feet and 2 feet, respectively, above the ground at the stations in the east and west experimental plots. Minimum temperatures registered by these thermometers during 10 clear, frosty nights before the east plot was plowed, and during 24 clear, frosty nights afterward, are given in Table 3. The average depression of the minimum temperature due to the presence of the cover crop, as shown by these unsheltered thermometers, was 0.5° at the 5-foot elevation and 1.1° at the 2-foot elevation.

Current temperature readings of the unsheltered thermometers made during cold nights, before and after the cover crop in the east plot was plowed under, are shown in Table 4. During the 1922 experiment large temporary differences in temperature between the cover crop and clean cultivated plots were noted during the earlier part of the night. It was believed these differences were due to light winds, which raised the temperature in the clean cultivated plot. No large temperature differences of this kind were noted during the latest experiment, due, it is believed, to the fact that the grove was well sheltered.

Because of the fact that the winter of 1923–24 was unusually dry, moisture was seldom deposited on any of the exposed thermometers. During the progress of the first experiment, in 1921–22, the lower exposed thermometers, especially in the cover-crop plot, were covered with water, ice, or frost on most clear nights.

ACTUAL DAMAGE RECORDS

Estimates made soon after a cold night, which indicate increased damage to fruit in orchards with cover crops, often have not been borne out by the packing-house records when the fruit was picked. Soon after the cold weather of early January, 1924, the manager of a packing house, who was firmly convinced that cover crops greatly increased the frost damage, made a careful estimate of the amount of damaged fruit in his district. He concluded that the damage had been much greater in orchards containing cover crops. However, later examinations made in the presence of the writer failed to confirm this belief.

An unusually close examination of the fruit from three adjoining orchards, on almost level ground, was made at the time the fruit was picked, to determine the amount of frost injury. The final record was as follows:

Grove No. 1, clean cultivation.—This grove contained the largest amount of frost-damaged fruit of the three groves considered. When picking was begun in the district, this grove showed so large a percentage of damaged fruit, as indicated by the presence of hesperidin crystals, that picking had to be stopped, and was postponed until near the end of the season, when much of the fruit had recovered.

Grove No. 2 (adjoining No. 1 on the north), in vetch cover crop.—See table below.

Grove No. 3 (adjoining No. 2 on the north), in vetch cover crop.—See table below.

The grade records for the three groves are given below.

Grove	Extra choice	Choice	Culls
	Per cent	*Per cent*	*Per cent*
No. 1	78.9	13.3	7.8
No. 2	79.4	11.1	9.5
No. 3	80.7	12.5	6.8

In this case the apparently increased amount of frost damage due to the presence of a cover crop in the grove was not verified by the actual damage records.

CONCLUSIONS

The results obtained from this experiment confirm in almost every detail the conclusions drawn from the experimental work carried on during the winter of 1921–22. The depression of the temperature due to the presence of the cover crop was somewhat greater in the latest experiment, but this was to be expected, since the area in cover crops was larger.

It is believed that the results obtained in the two experiments, conducted in different orchards and during two frost seasons, are reasonably conclusive, since they agree closely. Cover crops do increase the frost hazard, but only to a slight extent. In many cases the increased damage in presence of a cover crop is probably due to the fact that the grove is on lower ground, where the temperature is naturally lower. In other cases the increase may be accounted for by the small temperature differences which have been found in the experimental work.

Actual differences in the amount of damage between clean cultivated groves and those in cover crops, which can not be explained by the differences in temperature found in the two experiments, must be attributed to some other influence than temperature, such as decreased vigor of the tree, due to competition from the cover crop, a less dormant condition of the trees caused by more frequent irrigations, or increased deposit of moisture on the fruit and foliage from dew or frost, when a cover crop is present in the orchard.

From a study of all the experimental data it appears that the difference in temperature between a clean cultivated citrus grove and one in cover crop, especially during the earlier part of the night, is largely due to the

cover crop acting as a windbreak, allowing the cold air to accumulate near the ground, and preventing it from mixing with the warmer air above.

The condition of the surface soil with regard to moisture content was radically different during the two seasons when the experimental work with cover crops was in progress. During the winter of 1921–22 the ground was wet throughout the season, while it was unusually dry throughout the 1923–24 season. The results obtained should therefore be indicative of all seasons, whether wet or dry.

TABLE 1.—*Minimum temperatures on frosty nights (sheltered thermometers)*

ENTIRE GROVE STILL IN COVER CROP

Date	5-foot elevation		Difference	10-inch elevation		Difference
	East plot	West plot		East plot	West plot	
Dec. 18	35.2	35.0	−0.2	34.0	33.9	−0.1
Dec. 20	30.2	30.2	.0	30.6	30.5	−.1
Dec. 21	29.3	28.7	−.6	29.7	29.0	−.7
Dec. 22	29.5	29.8	+.3	29.0	28.9	−.1
Dec. 23	32.0	32.2	+.2	29.7	29.7	.0
Dec. 25	34.0	34.0	.0	31.1	31.0	−.1
Dec. 31	29.5	29.3	−.2	30.0	29.7	−.3
Jan. 1	30.1	30.4	+.3	31.0	30.2	−.8
Jan. 2 [1]	22.6	22.8	+.2	23.0	22.7	−.3
Jan. 3 [2]	26.4	26.1	−.3	26.1	25.9	−.2
Average	29.9	29.8	−.1	29.4	29.2	−.2

[1] 11:55 a. m., ground unfrozen under cover crop; frozen where bare; frost in the shade; cover crop wet; cover crop plants badly wilted and lying on ground.
[2] 10:20 a. m., ground unfrozen under cover crop, but frozen hard where bare; tender foliage on orange trees killed. Frost still on ground and vegetation in the shade.

TABLE 2.—*Minimum temperatures on frosty nights (sheltered thermometers)*

EAST PLOT, CLEAN CULTIVATION; WEST PLOT IN COVER CROP

Date	5-foot elevation		Difference	10-inch elevation		Difference
	East plot	West plot		East plot	West plot	
Jan. 4	33.9	33.1	−0.8	33.0	31.3	−1.7
Jan. 5	32.9	32.3	−.6	31.2	29.7	−1.5
Jan. 6	31.0	30.3	−.7	30.2	28.6	−1.6
Jan. 7	34.2	33.9	−.3	33.0	30.8	−2.2
Jan. 8	30.0	29.5	−.5	29.3	28.7	−.6
Jan. 9	30.6	30.1	−.5	30.3	29.7	−.6
Jan. 10	34.4	33.9	−.5	33.4	31.7	−1.7
Jan. 11	33.0	32.8	−.2	32.2	30.0	−2.2
Jan. 12	33.2	32.3	−.9	32.3	30.3	−2.0
Jan. 13	29.5	27.9	−1.6	29.0	27.3	−1.7
Jan. 14	32.3	32.4	+.1	31.4	30.3	−1.1
Jan. 15	33.5	33.7	+.2	32.1	29.9	−2.2
Jan. 16	31.0	29.5	−1.5	30.3	28.9	−1.4
Jan. 17	31.0	31.0	0	30.2	29.0	−1.2
Jan. 18	29.7	29.7	0	29.3	29.0	−.3
Jan. 19	29.9	29.7	−.2	29.2	28.5	−.7
Jan. 20	31.1	29.7	−1.4	29.9	27.9	−2.0
Jan. 21	29.7	28.2	−1.5	29.1	26.4	−2.7
Jan. 22	31.7	30.1	−1.6	30.9	28.4	−2.5
Jan. 23	30.8	30.7	−.1	30.1	29.0	−1.1
Jan. 24	26.0	26.0	0	26.2	26.0	−.2
Jan. 25	29.8	29.6	−.2	29.9	28.8	−1.1
Jan. 26	33.1	33.4	+.3	32.0	30.1	−1.9
Jan. 27	35.9	33.3	−2.6	34.7	32.9	−1.8
Average	31.6	31.0	−.6	30.8	29.3	−1.5

TABLE 3.—*Minimum temperatures on frosty nights (unsheltered thermometers)*

ENTIRE GROVE STILL IN COVER CROP

Date	5-foot elevation		Difference	2-foot elevation		Difference
	East plot	West plot		East plot	West plot	
Dec. 18	33.9	34.0	+0.1	33.1	33.8	+0.7
Dec. 20	28.9	29.0	+.1	28.7	29.7	+1.0
Dec. 21	28.1	27.3	−.8	28.3	27.9	−.4
Dec. 22	28.0	28.9	+.9	27.5	28.8	+1.3
Dec. 23	30.7	31.3	+.6	29.7	29.7	0
Dec. 25	32.9	32.9	0	31.1	32.0	+.9
Dec. 31	27.9	28.0	+.1	28.0	28.9	+.9
Jan. 1	28.8	28.9	+.1	28.8	29.5	+.7
Jan. 2	21.0	21.3	+.3	21.0	22.0	+1.0
Jan. 3	25.4	25.3	−.1	25.0	25.7	+.7
Average	28.6	28.7	+.1	28.1	28.8	+.7

EAST PLOT CLEAN CULTIVATION; WEST PLOT IN COVER CROP

Jan. 4	32.5	32.2	−.3	32.3	32.0	−0.3
Jan. 5	31.1	31.1	0	30.2	30.4	+.2
Jan. 6	30.0	29.5	−.5	30.3	29.1	−1.2
Jan. 7	33.5	32.4	−1.1	32.7	31.9	−.8
Jan. 8	28.9	29.2	+.3	28.5	28.5	0
Jan. 9	29.7	29.1	−.6	29.6	29.5	−.1
Jan. 10	33.3	33.0	−.3	33.0	32.4	−.6
Jan. 11	31.8	31.5	−.3	31.4	30.9	−.5
Jan. 12	31.2	31.1	−.1	31.0	30.9	−.1
Jan. 13	28.3	27.2	−1.1	28.2	27.2	−1.0
Jan. 14	31.1	31.3	+.2	30.7	30.9	+.2
Jan. 15	32.0	32.0	0	31.2	31.3	+.1
Jan. 16	29.8	28.9	−.9	29.6	28.9	−.7
Jan. 17	30.0	30.1	+.1	29.7	29.4	−.3
Jan. 18	28.7	28.4	−.3	28.3	28.4	+.1
Jan. 19	28.4	28.3	−.1	28.0	28.1	+.1
Jan. 20	29.8	28.8	−1.0	29.0	27.9	−1.1
Jan. 21	28.1	27.1	−1.0	28.0	26.9	−1.1
Jan. 22	30.4	29.3	−1.1	30.0	28.9	−1.1
Jan. 23	29.7	29.4	−.3	29.3	29.1	−.2
Jan. 24	25.0	25.1	+.1	24.9	25.3	+.4
Jan. 25	28.8	28.2	−.6	28.7	28.4	−.3
Jan. 26	32.1	32.0	−.1	31.6	31.6	0
Jan. 27	34.1	32.8	−1.3	34.0	32.6	−1.4
Average	30.3	29.9	−.4	30.0	29.6	−.4

TABLE 4.—*Current temperatures (unsheltered thermometers)*

ENTIRE GROVE STILL IN COVER CROP

Date	Time	5-foot elevation		Difference	2-foot elevation		Difference
		East plot	West plot		East plot	West plot	
Dec. 20	5:45 p. m.	39.3	39.4	+0.1	38.3	38.9	+0.6
Dec. 21	8:40 p. m.	34.7	35.4	+.7	33.9	34.9	+1.0
Dec. 22	8:55 p. m.	34.0	34.0	0	32.0	33.0	+1.0
Dec. 23	3:00 a. m.	33.2	34.6	+1.4	31.3	32.9	+1.6
Jan. 1	9:20 p. m.	26.0	25.9	−.1	25.4	26.0	+.6
Jan. 2	3:30 a. m. [1]	22.9	24.3	+1.4	22.7	23.8	+1.1
Jan. 2	9:30 p. m.	28.9	28.8	−.1	28.0	28.4	+.4

EAST PLOT CLEAN CULTIVATION; WEST PLOT IN COVER CROP

Jan. 5	9:25 p. m.	37.7	35.6	−2.1	37.0	34.7	−2.3
Jan. 6	10:42 p. m.	37.9	37.9	0	37.1	37.0	−.1
Jan. 8	10:45 p. m.	40.0	37.5	−2.5	39.4	37.4	−2.0
Jan. 9	11:15 p. m.	36.1	36.6	+.5	35.6	34.3	−1.3
Jan. 10	12:05 a. m.	38.1	36.0	−2.1	37.2	35.1	−2.1
Jan. 10	1:05 a. m.	37.0	37.3	+.3	36.5	36.3	−.2
Jan. 10	2:00 a. m.	37.9	38.9	+.1	37.2	37.3	+.1
Jan. 10	4:00 a. m.	38.0	36.7	−1.3	37.3	35.9	−1.4
Jan. 10	5:00 a. m.	35.8	35.9	+.1	35.4	35.0	−.4
Jan. 10	6:00 a. m.	35.0	34.8	−.2	34.5	34.0	−.5
Jan. 17	8:45 p. m.	36.7	36.2	−.5	36.1	35.6	−.5
Jan. 17	10:00 p. m.	35.0	34.2	−.8	34.6	33.7	−.9
Jan. 17	11:25 p. m.	34.9	36.0	+1.1	34.5	35.0	+.5
Jan. 18	5:00 a. m.	29.6	31.0	+1.4	29.0	29.9	+.9
Jan. 23	9:05 p. m.	35.8	35.0	−.8	35.5	34.9	−.6
Jan. 25	5:40 a. m.	29.6	28.8	−.8	29.3	28.7	−.6

[1] Vegetation on ground frozen stiff. All plants wilted; some brittle. No frost on thermometers. Ground not frozen under cover crop, but frozen hard where bare.

THE THREE TO THREE-AND-ONE-HALF YEAR PERIODIC PRESSURE OSCILLATION IN THE FREE ATMOSPHERE

By FRANZ BAUR

[Translation by H. C. Frankenfield from Beiträge zur Physik der freien Atmosphäre Bd XII, Heft 1, 1925]

Through employment of the periodogram analysis, which permits a clearer comprehension and a more nearly correct conclusion as to the physical reality of the existing periods, rather than through the usual methods for the disclosure of meteorological periods, I have in an earlier study [1] brought out the fact that along with other real periods of pressure fluctuation in Bavaria a period of about three years also occurs which has every appearance of reality. The progress of the investigation, which will be published in another place, revealed also similar periods in the pressure oscillations of other regions. The question now arises as to what the physical conditions are that produce this three to three and one-half year period. It is important to the solution of the question to gain a clear conception as to whether this oscillation is a result of periodical density (temperature) oscillations of the lower atmospheric strata, or one evolved through thermal or purely dynamic processes in the upper strata. A contribution toward the solution of these conditions forms the subject of the following investigation.

The observational material.—Annual pressure means based on suitable computations will be found in the table at the end of the paper. The pressure means for the various altitudes above Lindenberg are computed from the annual surface pressure means, the annual temperatures of the individual upper strata and the mean relative humidity. These observational results were given me in very excellent manner by Prof. J. Reger, Lindenberg. The material is not strictly homogeneous; as only in the years 1914–1916 were the mean annual temperatures computed from three daily ascents, and in the remaining years from the early ascents only. Furthermore there is involved in the pressure means computed from the temperatures the small defect that the pressure was not determined for each single ascent, and the annual mean computed therefrom, but that the annual pressure mean was derived from the annual temperature mean. Nevertheless the magnitude of this error in annual mean falls below 0.1 mm. Hg. The pressures at the surface are the means of the three hours 7 a. m., 2 p. m., and 9 p. m. In order to ascertain to what extent the results are conditioned by fortuitous values, pressure observations at a few high-altitude stations and their base stations were used for comparison. The annual mean pressures at four Bavarian lowland stations are from the above-mentioned work,[2] and those for high Peissenberg and for the Zugspitze for the respective years are from the German Meteorological Yearbooks for Bavaria. The annual mean pressures for Zurich and for Säntis were kindly given me by the Swiss Central Meteorological Institute.

The analysis.—As observations at Lindenberg are available from 1906 to 1920 only, the analysis could cover only a 16-year period. But this entire period was used because as a multiple of 3.2 it permitted the expectation that a period lying very probably between three and three and one-half years would be revealed, and because, moreover, 16 years are even multiples of 8 and 3.2 years, in proximity to which also probably lie the actual periods of pressure oscillation.[3] A complete periodogram-analysis naturally can not carry through with only 16 ordinates but nevertheless the Fourier analysis of 16 equidistant values beyond the 3.2 year period under investigation yields the amplitudes of six more periods than can be exhibited for comparison. That among these are some which closely approximate the existing real periods is of advantage for the accuracy of the results; as in the computation of periodic phenomena by means of the Fourier analysis it is especially important that the series of years analyzed should be as nearly as practicable a multiple of the existing periods.

To facilitate the computation of the Fourier coefficients I have formulated the following scheme and utilized it in the present investigation.[4] (See scheme below.)

Results.—The amplitudes derived are assembled in the table at the end of the paper. It will be seen that in nine pressure analyses the amplitudes of the 3.2-year period in seven cases showed the largest value and also in seven cases the amplitude is greater than one and one-half times the total of the arithmetical means of the amplitude derived from each analysis. By themselves the analyses of series of observations derived from only 16 yearly means warrant no conclusion as to the reality of the periodicity; but as the existence of this period has already been shown to be very probable, through the investigation before mentioned, which covers a longer term of years, the evident maximum of the amplitudes of the 3.2-year periods shown by the pressure analyses in the present paper may be interpreted as a new confirmation of the existence of about a three-year pressure oscillation.

Scheme for analysis of an empirically derived function in sine curves by means of 16 equidistant ordinates:

	y_1	y_2	y_3	y_4	y_5	y_6	y_7	y_8	
	y_{16}	y_{15}	y_{14}	y_{13}	y_{12}	y_{11}	y_{10}	y_9	
Difference:		u_1	u_2	u_3	u_4	u_5	u_6	u_7	
Sum:	v_0	v_1	v_2	v_3	v_4	v_5	v_6	v_7	v_8

Sine member

						u_1 u_7	u_2 u_6	u_3 u_5	u_4	U'_1 U'_3 U'_5
Sum						U_1	U_2	U_3	U_4	U''_1 U''_3
Difference						U'_1	U'_2	U'_3		U'''_1

	1——7	2——6	3——5	4
Sin. 22½°×	U_1		$-U_2$	
Sin. 45°×	U_3	U''_1	U_3	
Sin. 67½°×	U_5		U_1	
Sin. 90°×	U_4	U''_2	U_4-	U'''_1
Sum, column 1				
Sum, column 2				
Sum	$8a_1$	$8a_2$	$8a_3$	$8a_4$
Difference	$8a_7$	$8a_6$	$8a_5$	

Cosine member

						v_0 v_8	v_1 v_7	v_2 v_6	V'''_0 V'''_2	V'''_1
Sum						V_0	V_1	V_2	W_0	W_1
Difference						V'_0	V'_1	V'_2	W_2	

	0——8	1——7	2——6	3——5	4
Sin. 22½°×		V'_3		V'_1	
Sin. 45°×		V'_2	V''_1	$-V'_2$	
Sin. 67½°×		V'_1		$-V'_3$	
Sin. 90°×	W_0 W_1	V'_0	V''_0	V'_0	W_2
Sum, column 1					
Sum, column 2					
Sum	$16b_0$	$8b_1$	$8b_2$	$8b_3$	$8b_4$
Difference	$16b_8$	$8b_7$	$8b_6$	$8b_5$	

[1] F. Baur, Mehrjährige periodische Schwankungen des Niederschlags und des Luftdrucks im rechtsrheinischen Bayern (Deutsches Meteorol. Jahrbuch für Bayern 1922, Anhang D.)

[2] Loc. cit. Seite D. 7, Tabelle 2.

[3] Loc. cit. Seite D 4 und D 5.

[4] (Cf. F. Baur, Meteorol. Zeitschr. 1922, S 289, und 1923, S 91.)

Then the amplitude is $r_\gamma = \sqrt{a^2_\gamma + b^2_\gamma}$, the phase $\varphi_\gamma =$ arc tg $\frac{8b_\gamma}{8a_\gamma}$.

For disclosure of possible underlying errors in the computation of coefficients one may appropriately employ the following proof:

1. $[(8a_1+8a_7) \cdot \sin. 22\frac{1}{2}° + (8a_2+8a_6) \cdot \sin. 45° + (8a_3+8a_5) \cdot \sin. 67\frac{1}{2}° + 8a_4] : 4 = u_1$.
2. $[(8a_1-8a_7+8a_3-8a_5) \cdot \sin. 45° + (8a_2-8a_6)] : 4 = u_2$.
3. $\Sigma 8 \cdot b_\gamma = 8 \cdot v_0$.
4. $[(8b_3-8b_5) \cdot \sin. 22\frac{1}{2}° + (8b_2-8b_6) \cdot \sin. 45° + (8b_1-8b_7) \cdot \sin. 67\frac{1}{2}° + (8b_0-8b_8)] : 4 = v_1$.

From the well-known formula for the pressure change at the surface

$$\Delta P = p\Delta\frac{P}{p} - \frac{Pgh}{RT^2}\Delta T$$

we have, if $\Delta T = O$, the "assumed value" of the amplitude of the 3.2-year pressure oscillation in the higher levels,

$$\Delta p = \Delta P \frac{p}{P}$$

in which ΔP indicates the amplitude at the surface, p and P the (16-year) mean of the pressure aloft and at the surface. Then we obtain:

For the 1,000-meter level above Lindenberg	$\frac{674.2}{750.6}$	$\cdot 1.021 = 0.917$
For the 2,000-meter level above Lindenberg	$\frac{595.4}{750.6}$	$\cdot 1.021 = 0.810$
For the 3,000-meter level above Lindenberg	$\frac{524.5}{750.6}$	$\cdot 1.021 = 0.713$
For the Zugspitze	$\frac{528.8}{676.6}$	$\cdot 0.743 = 0.581$
For the Säntis	$\frac{561.9}{719.3}$	$\cdot 0.634 = 0.495$

The fact that the amplitudes of the 3.2-year periods in all the higher strata are not less than the assumed value shows incontestably that the 3.2-year period pressure oscillations are based upon the periodic procedure aloft; the fact that throughout they are even greater than the assumed value and that their absolute values increase from the 1,000 to the 3,000 meter level above Lindenberg and from the high Peissenberg to the Zugspitze have their sufficient explanation in the results of the analysis of the annual mean temperature at 3,000 meters above Lindenberg and on the Zugspitze. The 3.2-year period in temperature is clearly shown aloft, and, indeed, the temperature maximum nearly coincides with the maximum pressure. The phase difference resulting from the computation (Zugspitze, 11° 19′, Lindenberg, 3,000 m., 25° 20′) may have its cause in the simultaneous existence of still other real periods that are not present in the temperature, or vice versa; and, moreover, at Lindenberg the lack of homogeneity of the data exercised a limited influence in the way of an apparent phase disarrangement. The nearly simultaneous temperature increase with pressure increase at the 3,000-meter level permits the assumption that the periodic pressure oscillation is not a pure dynamic effect but that the pressure increase may be ascribed to a cold inflow in the stratosphere combined with warming of the troposphere; the oscillation, that is to say, can be traced to the periodic displacement of the equatorial front.

Noteworthy also is the quite uniform increase over Lindenberg of phase relations with altitude. The maximum pressure occurs about 9 days earlier at the 3,000-meter level than at the 2,000-meter level and 9 days earlier at the latter than at 1,000 meters. There is perhaps reason to question the reality of these phase shiftings as the computations were made from annual means

Table of annual means, amplitudes, and phases

	Air pressure									Temperature	
	Lindenberg				Bavaria			Switzerland		Lindenberg	
	Surface	1,000 m.	2,000 m.	3,000 m.	On a plain (4 stations)	Higher Peissenberg	Zugspitze	Zurich	Säntis	3,000 m.	Zugspitze
	(122 m.)					(994 m.)	(2,962 m.)	(493 m.)	(2,500 m.)	°C.	°C.
Annual means:											
1905								19.9	62.0		
1906	50.1	73.8	95.1	24.3	28.62	76.6	29.5	19.5	61.9	−6.0	−5.2
1907	50.9	74.4	95.4	24.5	28.97	76.8	29.7	19.7	62.2	−6.3	−5.2
1908	51.8	75.4	96.7	25.9	29.77	77.5	30.2	20.4	62.7	−5.6	−5.1
1909	49.9	73.4	94.5	23.8	27.92	76.0	28.5	18.7	61.0	−6.8	−6.0
1910	49.0	72.9	94.3	23.7	27.12	75.6	28.6	18.0	60.8	−6.1	−5.6
1911	51.5	75.1	96.2	25.3	29.56	77.5	30.2	20.2	63.2	−6.5	−4.6
1912	50.1	73.5	94.5	23.4	28.46	76.3	28.3	18.4	61.8	−7.7	−5.5
1913	51.2	74.7	95.7	24.7	29.39	77.1	29.2	20.0	62.8	−6.7	−5.0
1914	50.4	74.3	95.7	24.9	28.57	76.3	28.6	19.2	62.0	−5.7	−4.8
1915	49.1	72.9	93.9	23.0	26.96	74.8	26.9	17.6	60.4	−7.3	−5.5
1916	48.8	72.8	94.2	23.5	27.10	75.2	27.6	17.9	61.0	−6.2	−4.5
1917	50.6	74.2	95.2	24.3	28.35	76.1	27.8	19.0	61.5	−6.6	−5.3
1918	51.3	75.1	96.3	25.4	29.31	77.3	29.1	20.0	62.7	−6.3	−4.8
1919	49.7	73.3	94.3	23.2	27.73	75.7	26.8	18.5	60.7	−7.5	−6.2
1920	52.4	75.8	97.1	26.4	30.03	78.0	29.9	20.5	63.4	−5.2	−3.3
1921	52.7	76.1	97.2	26.4	30.43	78.4	30.3			−5.3	−3.8
16-year mean	50.6 +700 mm. Hg.	74.2 +600 mm. Hg.	95.4 +500 mm. Hg.	24.5 +500 mm. Hg.	28.64 +700 mm. Hg.	76.6 +600 mm. Hg.	28.8 +500 mm. Hg.	19.3 +700 mm. Hg.	61.9 +500 mm. Hg.		
Amplitudes:											
16-year	0.698	0.595	0.610	0.654	0.626	0.685	**0.992**	0.511	0.270	0.461	0.326
8-year	0.680	0.554	0.517	0.445	0.699	0.661	0.474	0.542	0.524	0.251	0.419
5.3-year	0.337	0.272	0.201	0.116	0.418	0.272	0.283	0.563	0.369	0.284	0.328
4-year	0.493	0.380	0.380	0.415	0.419	0.381	0.276	0.276	0.213	0.285	0.305
3.2-year	**1.021**	**0.994**	**1.015**	**1.038**	**0.842**	**0.743**	0.772	**0.634**	0.629	**0.575**	**0.529**
2.7-year	0.239	0.298	0.338	0.345	0.252	0.290	0.333	0.140	0.136	0.237	0.212
2.3-year	0.404	0.402	0.426	0.468	0.408	0.403	0.553	0.451	**0.706**	0.216	0.409
r′=	0.553	0.409	0.498	0.497	0.523	0.491	0.526	0.445	0.406	0.330	0.361
1.5 r′=	0.830	0.749	0.747	0.746	0.785	0.736	0.789	0.668	0.610	0.495	0.542
Phase of the 3.2-year period from 1.VII, 1921	136° 24′	137° 38′	140° 23′	140° 3′	134° 49′	136° 30′	146° 15′	140° 26′	146° 11′	168° 23′	157° 34′

The boldface amplitudes are the maxima of either analysis. The underlined amplitudes are greater than 1.5 r′, where $r' = \frac{[r]}{7}$.

only. These doubts are well justified inasmuch as the true phase shifting is possibly of another magnitude; nevertheless the approach of the extreme of pressure oscillation earlier at the higher levels than at the lower appears to be real, as the phase shifting between Zugspitze and high Peissenberg (with respect to the Bavarian lowland) and between Säntis and Zurich agrees in direction and order of magnitude with that between Lindenberg at 3,000 meters and the surface. It may be seen therefrom how much more precise is the analytical than the customary graphic method for the investigation of periodic processes. In a horizontal direction there results a phase shifting from south to north in such a way that on Säntis (lat. 47° 15′) and on the Zugspitze (lat. 47° 25′) the extreme oscillation occurs about 10 days earlier than at the 3,000-meter level over Lindenberg (lat. 52°). From this result the assumption is permissible that the three to three and one-half year pressure oscillation in central Europe is dependent upon a periodic displacement of the equatorial front.

RAINFALL PROBABILITY DURING THE FIRE SEASON IN WESTERN WASHINGTON AND OREGON[1]

By THORNTON T. MUNGER, Director

[Portland, Oreg., office of the Forest Service]

If forest protective effort were adequate to absolutely prevent and suppress all forest fires, there would be less occasion to study quantitatively the hazards. But the funds are not adequate to give absolute protection. Hence protection has to be skimped in one region to bolster up that in another. The most intelligent distribution of resources in proportion to needs can be made only after some quantitative study of the several factors that go to make up fire danger.

It would help in the solution of the problem if each of the factors that go to make up the fire hazard could be measured and rated for each district—even for each tract of land. This is a goal to strive for—to measure and rate the inflammability based upon the amount and character of the combustible material on that tract, to estimate and rate the probability of fire starting, and then to rate the meteorological factors, the probability and local severity of low humidity spells, winds, and the chances of wetting rains, and put these elements together to make a fire danger index rating.

The present report—which is chiefly a set of graphs and maps [The latter not reproduced.—Ed.] aims to set forth in a preliminary way the rating of just one of the factors that contribute to the fire hazard—rainfall probability.

It has always been known that certain parts of this region had more summer rainfall than others, that some valleys were phenomenally dry, others so likely to have summer moisture as to be little worry to the protective agencies. This study was undertaken to find out what the Weather Bureau records might show as to summer rainfall at various points throughout western Oregon and Washington.

The results as presented in the graphs and maps will be of practical use to the protective agencies in getting a picture of one of the big underlying predisposing causes of forest fires, in seeing how much chance of rain they have to count upon in this locality as compared with that locality. They can better meet their opponent in the fire-fighting game if they know what the odds are against them.

It may be appreciated that the weather at any one station may in any one year be absolutely the reverse of the probability; i. e., these percentage chances of rain can not be used as indications of coming weather at any one station in any one period. These probabilities will be dependable over a term of years for a group of stations, just so far as the weather during series of past years is duplicated in the future.

Methods of making this study.—These were suggested by a paper read by Raphael Zon at Madison, Wis., in March, 1924, describing methods of drought prediction in Russia based on probabilities and entitled "Theory of probabilities in relation to climatic cycles as developed in Russia."

The present study consisted of assembling the United States Weather Bureau statistics for the region in such a way as to show how often during a term of years each station has had a good rain, a light rain, or no rain during each 10 days of the fire season. The printed records were used so far as they went, and beyond that the original records in the archives of the Portland and Seattle offices were consulted through the courtesy of Messrs. E. L. Wells and M. B. Summers. The compilation was performed by Mr. Louis Langdell.

All the stations in Western Oregon and Washington were used which had 10 or more years complete summer record. It so happened that there were exactly 50 such stations in each State. The compilation was prepared separately for each 10-day period from June 20 to September 10, which in the case of the last third of July and of August is actually an 11-day period. If a station in any 10-day period had 0.2 inch or more of rain in one or two days it was considered to have had a "wetting rain" or "good rain" in that period. This amount which has been used by other writers,[2] was selected arbitrarily as that which would subdue the forest fire menace for a few days. Recognition is given of the fact that the rate at which a rain falls and the type of cover it falls upon has much to do with its fire-deterrent effect. Ten-day periods which had a trace or more of rain but less than 0.2 inch in any two days were classed as having "light rains." If a station had no rain in a 10-day period it was so classified. The results of all the years, whether it be 10 years or 41, were assembled by 10-day periods for each of the 100 stations, and the percentage of times in each period that each station had "wetting rains," "light rains," or "no rains" calculated. Thus Government Camp, for the period August 1 to 10, in the 25 years of record had wetting rains 7 times, light rains 3 times, and no rain 15 times. This indicates a probability of wetting rains 28 times out of 100, light rains 12 per cent of the time, and no rains 60 chances out of 100.

Presentation of data.—The results of analyzing this great mass of meteorological statistics are assembled in the graphs shown on pages 396–397, one for Washington and one for Oregon. They show for each station what its chances are (based on its history) for a good rain, a light rain, and no rain, all given in percentages, for each of the 10-day periods.

[1] The term "rainfall probability" as here used connotes percentage frequency of rainfall of certain intensities; it should not be confused with results which may be deduced by the methods of the mathematical theory of probability.—Ed.

[2] Gisborne in "Measuring and Forecasting Forest Fire Danger in Northern Idaho" considers that ".20 inches or more in 24 hours is sufficient to eliminate fire danger in northern Idaho."

Some irregularities in the graphs may be due to very local unusual conditions or exposure if instrument at some stations. The reading of any single station must be considered with this in mind.

Before the analysis of past weather records was begun it was realized that for most stations the length of record was not sufficient to give accurate normals. It would have been better if all stations had 30 to 50 years record.

Furthermore, the records of the several stations are not for contemporary periods, and as there are wet cycles and dry cycles it is evident that a 15-year record running from 1910 to 1924 is not truly comparable with a 30-year record running from 1895 to 1924. To have used only those stations which had contemporaneous records for the same term of years would have reduced the number of stations and years used to a point that the compilation would have been meaningless.

Discussion.—The graphs speak for themselves and can be used direct without further analysis. They drive home vividly certain things it is well for all forest agencies to realize. For example, the coastal regions have much better probability of rain than the interior valleys, and the Cascade Range is wetter than the valleys but less so than the coastal belt. There is a progressive decrease in the chances for rain from north to south varying from a midsummer chance of 36 per cent in the northern Cascades to a 3 per cent in the southern. The acute shortage of rain begins earlier, is more intense, and lasts longer in the south, and this principle is true of the coast belt and Cascades as well as the valleys.

On the whole, western Oregon has a very much poorer chance of summer rains than western Washington. A comparison of the two States is presented in Table 1. The stations are very similarly distributed by physiographic regions in the two States, so that the comparison is fair.

Table 2 gives a comparison of the several physiographic regions of the two States and shows the marked contrasts that exist. It is compiled from the detailed entries by stations given in the graphs.

The periods of July 20–31 and August 1–10 are the worst of the season so far as lack of rainfall is concerned. The last 10 days of June and first 10 days of September are about the same in this regard. This does not check with the fire record because other factors than precipitation make the late August season the peak of the danger period, particularly the cumulative effect of the droughts, the seasonal maturing and withering of weeds, and the lowered moisture content of all vegetabtion and the increase in the human risk due to the vacation season. These factors tend to outweigh the slight increase in precipitation. If the graphs of one period be compared with those of another, it must be remembered that they are the picture of but one factor and not of the cumulative combination of all the elements of fire risks.

The graphic pictures of this one element of the weather should be used only within the limitations which this text specifies. If they help to acquaint the forest protective agencies with the customary seasonal and regional distribution of our fire-quenching showers they will have served the purpose for which they were intended.

68437—25†——2

TABLE 1.—*Chance of good rains and chance of no rains in the summer in western Oregon and in western Washington; average of 50 stations in each State.*

	June 20–30	July 1–10	July 11–20	July 21–31	Aug. 1–10	Aug. 11–20	Aug. 21–31	Sept. 1–10
	Chance of good rain, in percentage, through term of years							
Western Washington	69	49	39	26	24	48	46	72
Western Oregon	52	31	21	15	14	25	30	49
	Chance of no rain, in percentage, through term of years							
Western Washington	8	28	32	32	44	23	26	8
Western Oregon	25	45	52	54	63	47	40	30

TABLE 2.—*Chance of good rains in each region during the summer; averages of stations in each region*

	June 20–30	July 1–10	July 11–20	July 21–31	Aug. 1–10	Aug. 11–20	Aug. 21–31	Sept. 1–10
	Chances of good rains, in percentage, through a term of years							
Washington:								
North coastal	63	43	40	32	27	53	54	72
South coastal	76	46	41	33	24	49	39	80
East Olympic	62	43	33	17	22	44	44	51
Puget-Cowlitz	64	46	37	23	21	44	44	68
North Cascades	76	67	46	31	36	55	52	58
South Cascades	78	52	40	27	27	53	45	79
Oregon:								
North constal	70	39	30	30	21	37	40	62
South coastal	54	27	20	9	14	17	30	50
Willamette Valley	56	30	16	11	13	19	30	48
Umpqua-Rogue	30	24	14	8	8	20	14	34
North Cascades	68	46	26	26	25	42	51	64
South Cascades	46	38	37	14	3	25	23	56

WASHINGTON-West of Cascades

PROBABILITY OF GOOD RAIN, LIGHT RAIN, AND NO RAIN

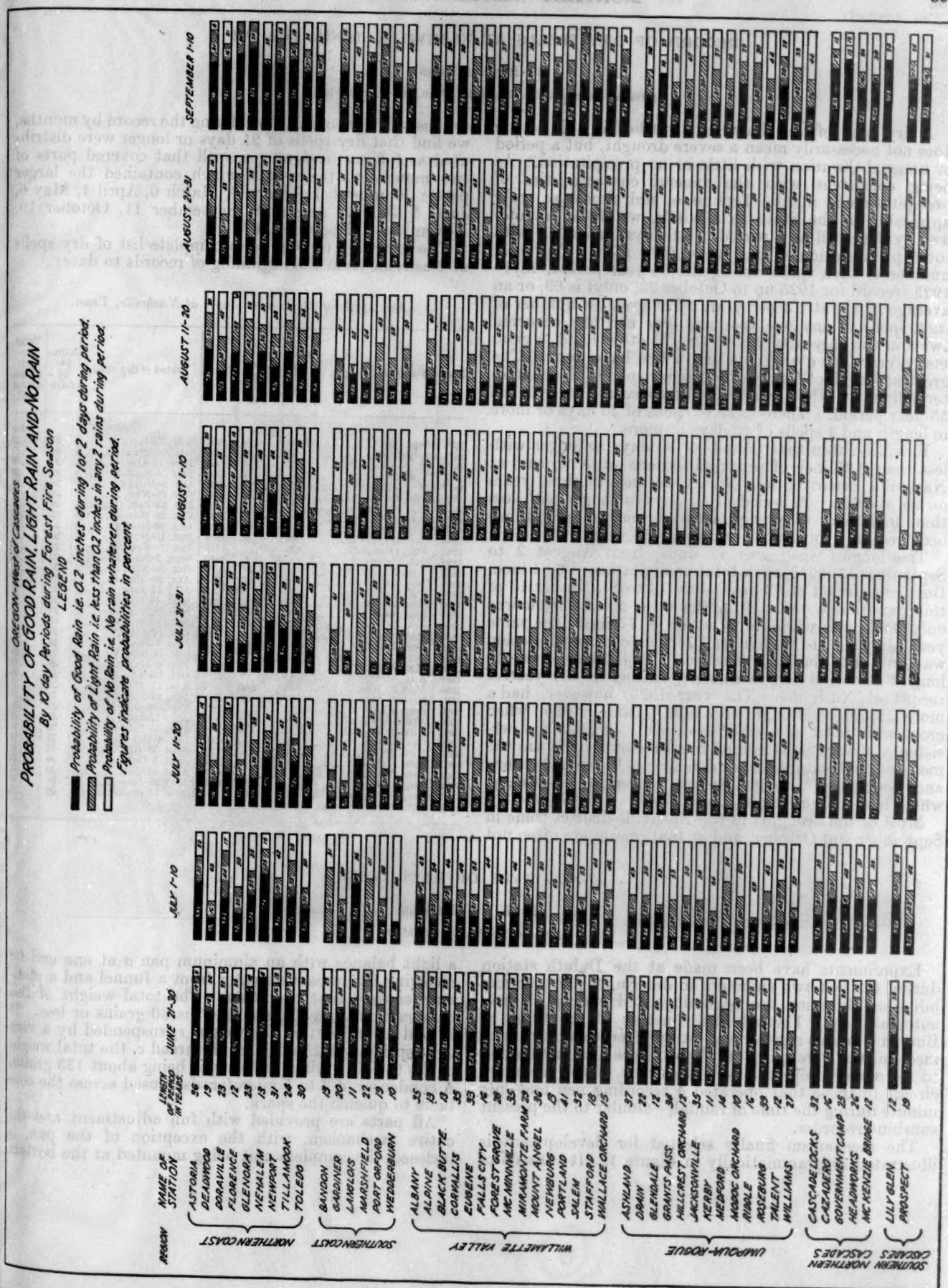
By 10 day Periods during Forest Fire Season

LEGEND

Probability of Good Rain i.e. .02 inches during 1 or 2 days during period.
Probability of Light Rain i.e. less than .02 inches in any 2 rains during period.
Probability of No Rain i.e. No rain whatever during period.
Figures indicate probabilities in percent.

REGION	NAME OF STATION	LENGTH OF PERIOD IN YEARS	JUNE 21-30	JULY 1-10	JULY 11-20	JULY 21-31	AUGUST 1-10	AUGUST 11-20	AUGUST 21-31	SEPTEMBER 1-10
NORTHERN COAST	CLEAR WATER	12	52 24	54 28	52 33	52 33	52 33	52 33	52 33	52 33
	FORKS	13	55	56	54 31 37	54 31 33	54	54	54	54
	PORT ANGELES	11	55 23	54 37	54 37	54	54 33	54	54 23 31	54
	PORT CRESCENT	16	53 23	53 44	53 44 31	53	53	53	53	53
	QUINAULT	13	54 20 18	54	54 33	54	54	54	54	54
	TATOOSH ISLAND	20	55	55 40	55 40	55	55	55	55	55
SOUTHERN COAST	ABERDEEN	29	54 14	54	54	54	54	54	54	54
	LONE TREE	12	54	54 33 17	54 41 17	54	54	54	54	54
	NORTH HEAD	21	54	54 33	54	54	54	54	54	54
	SOUTH BEND	26	55	55 33	55 31	55	55	55	55	55
EAST OLYMPIC	BREMERTON	22	54 23 14	54 23 23	54 23 36	54 36	54	54	54	54
	GRAPEVIEW	17	55 18 23	54 41	54 47	54 41	54	54	54	54
	PORT TOWNSEND	30	55 23 17	54 37 23	54 43 33	54 43 33	54	54	54	54
	UNION CITY	14	54 23	54 36	54 38 43	54 36	54	54	54	54
PUGET-CONLITZ VALLEYS	ANACORTES	27	54 20 33	54 20 37	54 18 38	54 33	54	54	54	54
	BELLINGHAM	31	55 18 16	54 33	54 33	54 43 33	54	54	54	54
	BLAINE	24	54 23 18	54 33	54 33	54 46 33	54	54	54	54
	CENTRALIA	21	54 24	54 33 29	54 24 53	54 47 39	54	54	54	54
	CLEAR BROOK	21	54 24	54 44 32	54 38	54 43 38	54	54	54	54
	COUPEVILLE	21	54 24 18	54 43 19	54 34 53	54 43 43	54	54	54	54
	EAST SOUND	12	54 33	54 33 36	54 31 17	54 30 33	54 33	54	54	54
	EVERETT	10	54 30 20	54 30 20	54 24 40	54 30 40	54 30	54	54	54
	GRAND MOUND	10	54 20	54 40 20	54 30	54 30	54 30	54	54	54
	KENT	11	54 37 8	54 33	54 37 36	54 37 43	54	54	54	54
	LA CENTER	25	54	54 33 36	54 44 38	54 40 36	54	54	54	54
	MARIETTA	10	54 30 10	54 30 40	54 30 40	54	54	54	54	54
	OLGA	33	54 33	54 33 21	54 33 37	54 37 39	54	54	54	54
	OLYMPIA	29	54 24	54 31 38	54 31 34	54	54	54	54	54
	PUYALLUP	11	54 46 18	54 55	54 36 27	54	54	54	54	54
	SEATTLE	33	54 43	54 33 18	54 43 18	54	54	54	54	54
	SEDRO-WOOLEY	26	54	54 33 19	54 33	54	54	54	54	54
	SNOHOMISH	23	54	54 33 17	54 30	54	54	54	54	54
	STATE UNIVERSITY	15	54 24 19	54 27 27	54 43 27	54	54	54	54	54
	SUMNER	12	54	54 17	54	54	54	54	54	54
	TACOMA	28	54 33	54 33 39	54 33 39	54	54	54	54	54
	VANCOUVER	27	54	54 33 37	54 37 37	54	54	54	54	54
	VASHON ISLAND	29	54	54	54	54	54	54	54	54
NORTHERN CASCADES	CEDAR LAKE	14	54	54 33	54 23 27	54	54	54	54	54
	DAVIS RANCH	14	54 24	54 43 22	54 23	54	54	54	54	54
	GRANITE FALLS	21	54	54 43 14	54 33 18	54	54	54	54	54
	LANDSBURG	15	54	54	54 23 40	54	54	54	54	54
	SNOQUALAMIE FALLS	24	54	54 23 21	54 46 12	54	54	54	54	54
SOUTHERN CASCADES	ASHFORD	13	54	54	54	54	54	54	54	54
	BUCKLEY	12	54	54 34	54 33 17	54	54	54	54	54
	ROSMOS	15	54	54 33 37	54 23 40	54	54	54	54	54
	LONGMIRES SPRINGS	12	54	54 33	54 33	54	54	54	54	54
	MOUNT PLEASANT	20	54	54 20 30	54 30 38	54	54	54	54	54
	WIND RIVER	13	54	54 38	54	54	54	54	54	54
	YACOLT	10	54	54 30	54	54	54	54	54	54
	YALE	13	54	54	54	54	54	54	54	54

OREGON-West of Cascades


PROBABILITY OF GOOD RAIN, LIGHT RAIN AND NO RAIN
By 10 day Periods during Forest Fire Season
OREGON-West of Cascades
LEGEND
Probability of Good Rain i.e. 0.2 inches during 1 or 2 days during period.
Probability of Light Rain i.e. less than 0.2 inches in any 2 rains during period.
Probability of No Rain i.e. No rain whatever during period.
Figures indicate probabilities in percent.
JULY 1-10
JULY 11-20
JULY 21-31
AUGUST 1-10
AUGUST 11-20
AUGUST 21-31
SEPTEMBER 1-10
REGION
NAME OF STATION
LENGTH OF PERIOD IN YEARS
JUNE 21-30
NORTHERN COAST
ASTORIA
DEADWOOD
DORAVILLE
FLORENCE
GLENORA
NETHALEM
NEWPORT
TILLAMOOK
TOLEDO
SOUTHERN COAST
BANDON
GARDINER
LANGLOIS
MARSHFIELD
PORT ORFORD
WEDDERBURN
WILLAMETTE VALLEY
ALBANY
ALPINE
BLACK BUTTE
CORVALLIS
EUGENE
FALLS CITY
FORESTGROVE
MCMINNVILLE
MIRAMONTE FARM
MOUNT ANGEL
NEWBURG
PORTLAND
SALEM
STAYTON
WALLACE ORCHARD
UMPQUA-ROGUE
ASHLAND
DRAIN
GLENDALE
GRANTS PASS
HILLCREST ORCHARD
JACKSONVILLE
KERBY
MEDFORD
MOORE ORCHARD
RIDDLE
ROSEBURG
TALENT
WILLIAMS
NORTHERN CASCADES
CASCADE LOCKS
CAZADERO
GOVERNMENT CAMP
HEADWORKS
MC KENZIE BRIDGE
SOUTHERN CASCADES
LILY GLEN
PROSPECT

RECORD OF DRY SPELLS AT NASHVILLE, TENN., 1871–1925

By ROSCOE NUNN

[Weather Bureau Office, Nashville, Tenn., October 23, 1925]

A dry spell of the character described in this article does not necessarily mean a severe drought, but a period of unusual duration with little or no precipitation. As being consistent with the general characteristics of precipitation in middle Tennessee, and almost as truly applicable to the State as a whole, we define a noteworthy dry spell as a period of 21 days, or longer, with total precipitation of less than 0.25 inch. The total number of such spells during the 55-year period, 1871–1925 (record for 1925 up to October 23, only) is 69, or an average of about 1.3 per year. The greatest number of such spells in any one year was four and this occurred twice in the 55-year period. On the other hand, a good many years have only one and a few have none. The greatest length of time without a dry spell of the character defined was three years, and this occurred twice in the 55-year period. There were 16 spells of 30 days or more in length and 4 spells of 40 days or more.

It will be seen that periods of 30 days or longer with less than 0.25 inch of precipitation are quite unusual at Nashville, occurring less often than once in three years on an average. A period of 40 days or longer with less than 0.25 inch of precipitation is very rare and has occurred only four times in the last 55 years.

The longest spell was 43 days, from August 2 to September 13, 1913, with total precipitation of 0.24 inch. But for a period of 63 days, July 13 to September 13 of this remarkable year, 1913, the total precipitation was only 0.94 inch, while for a period of 77 days, the same year, July 13 to September 27, the total precipitation was only 1.61 inches. The year 1913 thus shows the longest period of almost rainless weather of any year of record at Nashville. The year 1925, however, had a more disastrous drought, because it came earlier, when crops were most in need of moisture. In 1925 the persistency of very light rainfall month after month was the most marked feature; heavy deficiencies began in January and continued through August, excepting February, which had a slight excess.

Most of the droughts in the Nashville district come in September and October, and at that season are often not seriously detrimental. Considering the record by months, we find that dry spells of 21 days or longer were distributed as follows (assigning a spell that covered parts of two months to the month which contained the larger part): January 2, February 4, March 0, April 1, May 6, June 5, July 3, August 8, September 11, October 19, November 6, December 4.

The following table gives a complete list of dry spells at Nashville from the beginning of records to date:

Dry spells of 21 days or longer at Nashville, Tenn.

Year	Period of dry spell	Number of days	Total precipitation during spell	Year	Period of dry spell	Number of days	Total precipitation during spell
			Inches				*Inches*
1871	Sept. 16–Oct. 15	30	0.16	1903	Aug. 20–Sept. 26	38	0.18
1874	July 25–Aug. 25	32	.20	1903	Oct. 8–Oct. 31	24	.11
1875	Aug. 18–Sept. 9	23	.11	1903	Nov. 18–Dec. 11	24	.04
1876	Nov. 20–Dec. 23	34	.24	1904	Sept. 4–Sept. 24	21	.06
1877	May 9–June 4	27	.06	1904	Oct. 6–Nov. 2	28	.17
1877	Nov. 28–Dec. 22	26	.24	1905	Oct. 26–Nov. 23	29	.20
1879	Sept. 14–Oct. 6	23	0	1906	Jan. 23–Feb. 19	28	.21
1879	Oct. 17–Nov. 8	23	.17	1906	Oct. 19–Nov. 10	23	.19
1880	July 11–Aug. 1	22	.21	1908	Oct. 10–Nov. 9	31	.02
1884	Oct. 30–Nov. 22	24	.24	1909	Oct. 15–Nov. 8	25	.04
1885	Aug. 14–Sept. 7	25	.08	1910	Jan. 21–Feb. 10	21	.19
1886	Oct. 15–Nov. 8	25	.20	1910	Sept. 2–Sept. 24	23	.24
1887	Aug. 27–Sept. 16	21	.07	1910	Oct. 28–Nov. 23	27	.15
1891	Sept. 12–Oct. 3	22	0	1911	Apr. 20–May 19	30	.22
1891	Oct. 19–Nov. 8	21	.12	1911	May 23–June 18	27	.21
1892	Sept. 21–Oct. 22	32	.23	1911	Sept. 18–Oct. 8	21	.09
1894	Sept. 19–Oct. 28	40	.17	1912	Nov. 7–Nov. 30	24	.20
1896	Oct. 12–Nov. 3	23	.24	1913	Aug. 2–Sept. 13	43	.24
1897	May 14–June 6	24	.12	1914	Dec. 29–Jan. 23	26	.19
1897	Sept. 1–Oct 10	40	.19	1914	May 7–June 13	38	.24
1898	Feb. 12–Mar. 12	29	.18	1914	Oct. 18–Nov. 7	21	.01
1898	May 23–June 12	21	.09	1915	Feb. 6–Mar. 3	26	.15
1898	Aug. 10–Sept. 1	23	0	1915	Oct. 15–Nov. 7	24	.16
1899	May 23–June 25	34	.16	1917	Apr. 13–May 3	21	.15
1899	June 29–July 20	22	.11	1919	Dec. 14–Jan. 5	23	.24
1899	Aug. 8–Aug. 29	22	.15	1920	Sept. 26–Oct. 24	29	.06
1900	Apr. 24–May 17	24	.24	1921	May 12–June 14	34	.23
1900	July 29–Aug. 22	25	.19	1921	June 25–July 18	24	.21
1900	Oct. 23–Nov. 18	27	.15	1921	Oct. 4–Oct. 26	23	.09
1900	Nov. 27–Dec. 18	22	.24	1922	Sept. 21–Oct. 22	32	.16
1901	Feb. 12–Mar 8	25	.18	1923	Sept. 8–Oct. 16	39	.22
1901	June 10–June 30	21	.23	1924	Sept. 29–Nov. 7	40	.11
1901	Aug. 24–Sept. 13	21	.02	1925	May 18–June 17	31	.05
1901	Oct. 13–Nov. 2	21	.08	1925	Aug. 15–Sept. 11	28	.12
1902	Oct. 14–Nov. 4	22	0				

A NEW TYPE OF RAIN TIMER

By F. N. HIBBARD

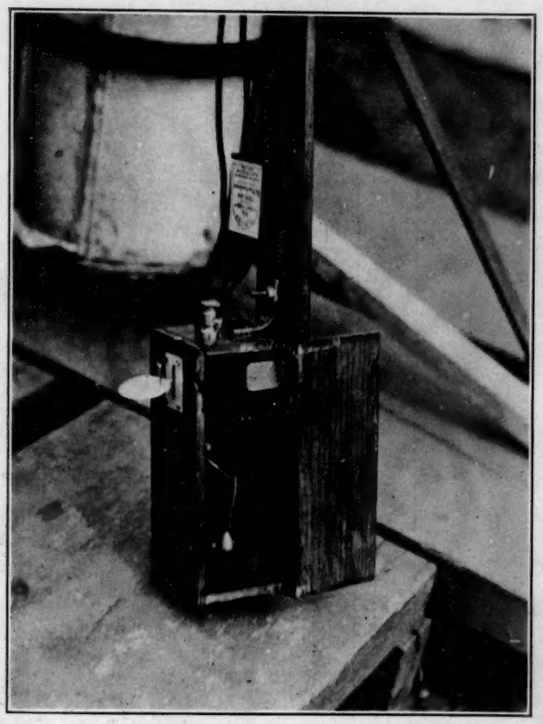
[Weather Bureau, Duluth, Minn.]

Experiments have been made at the Duluth station during the last two summers to determine the practicability of obtaining the beginnings and endings of rain automatically. Through the courtesy of the Chief of Bureau a double register was put into service and various mechanisms were tried out, from those that attempted to use water drops themselves as part of the recording circuit to those that operated a recording pen once per minute during the time of rainfall—similar to the present sunshine recorder.

The mechanism finally selected for development is illustrated diagrammatically in Figure 1. It consists of a light balance with an aluminum pan *a* at one end for receiving the impact of water from a funnel and a platinum contact *b* at the other. The total weight of this balance, including the spindle *f*, is 30 grains or less. It is held in position by the weight *e*, suspended by a very light spring *d* and multiple silk thread *c*, the total weight of the thread, spring, and weight being about 135 grains. A condenser of 3 to 5 microfarads is used across the contacts to quench the spark.

All parts are provided with full adjustment and the entire mechanism, with the exception of the pan, is inclosed, the complete unit being mounted at the bottom

(To face p. 398)



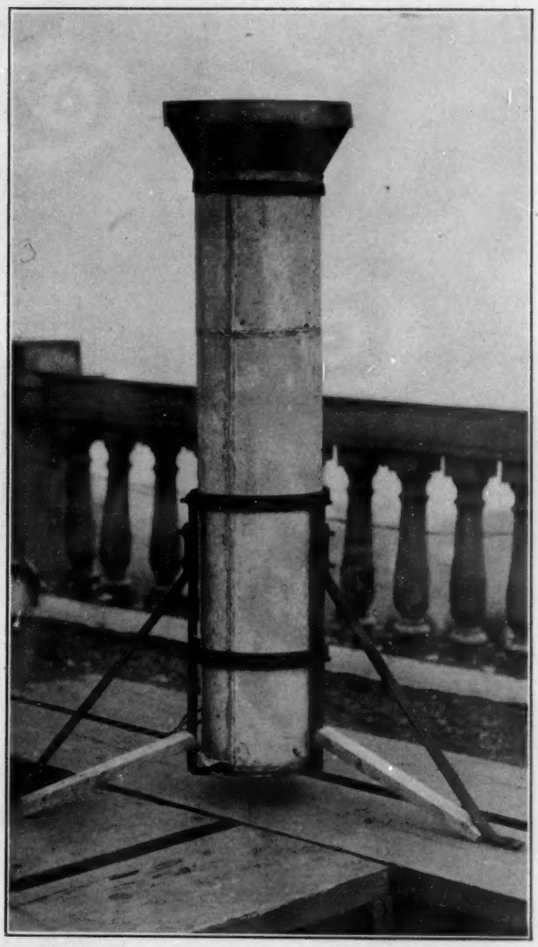


FIG. 2.—Hibbard rain timer, and its funnel container

(To face p. 399)

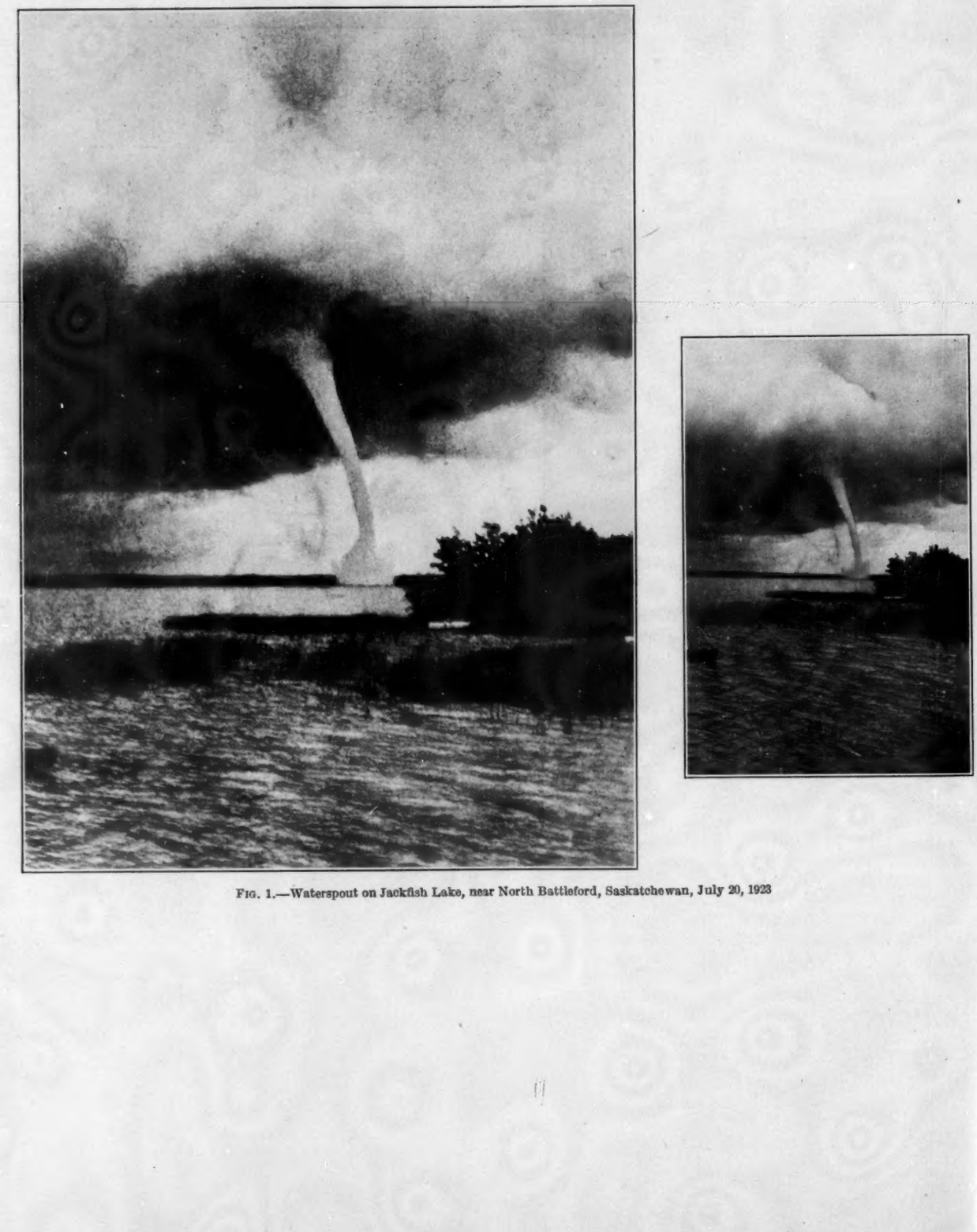


FIG. 1.—Waterspout on Jackfish Lake, near North Battleford, Saskatchewan, July 20, 1923

of a cylinder 8 inches in diameter and 38 inches deep, shown in Figure 2. Linen cloth forms the bottom of the cylinder, and a 12-inch funnel collector is fitted at the top. Special precautions are taken in mounting the gauge solidly to eliminate vibration.

It is found that this form of balance properly adjusted responds readily to the impact of water from the funnel, and with a battery of 3.5 volts one action of the magnet on a chronographic register is effected by each drop from the funnel irrespective of whether the pan is weighted with water or dry. The balance is durable and retains its adjustment well.

Both times and amounts of rainfall are recorded on a single sheet. It is of interest to note that only a slight interval correction needs to be applied to the beginnings of rain and that the drainage from the funnel, or from any funnel, lasts several minutes and continues to close the circuit considerably after the end of rain. Dripping fog or dew also records, but the checks therefrom are quite characteristic and can not be confused. Of the many scores of records obtained from the Duluth instrument rain invariably made the checks close enough to coalesce, and no very heavy dripping fog has been known to bring them closer together than a minute, or nearly a minute. The fog record is also readily distinguished from funnel drainage, the checks from funnel drainage gradually getting farther apart.

The critical part of a timer is the funnel. Many experiments have been made with various coatings and materials, but the best so far found is the plain weathered zinc or copper surface, which starts the drops down by capillarity. The threshold value of such a surface is small, and our experience has been that a timer so equipped picks up the time somewhat better than an observer under average conditions during the day and preeminently better during the night. No timer, however ingenious, can equal the alert human eye; the best that can be hoped for is an instrument that will not fail to record on all precipitation greater than a very small and perhaps negligible trace.

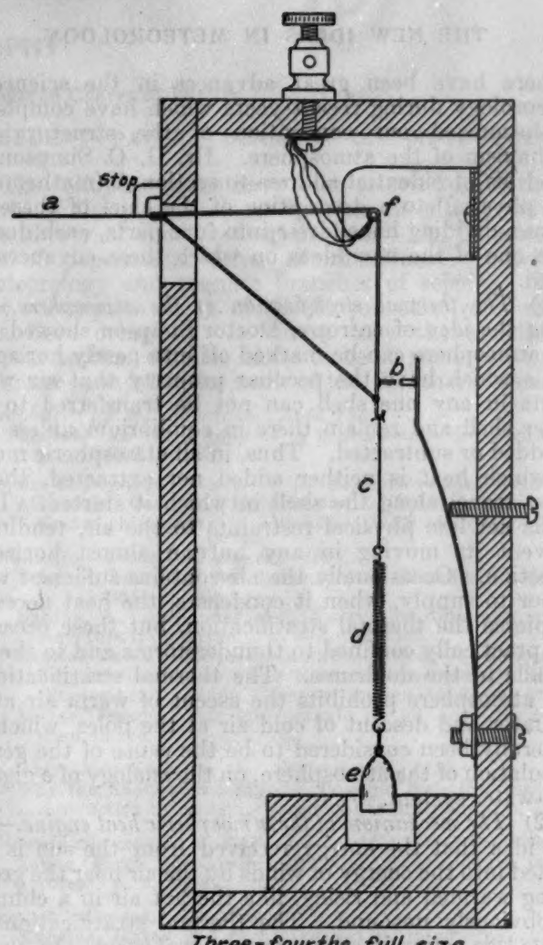


Fig. 1.—Details of the Hibbard rain timer

NOTES, ABSTRACTS, AND REVIEWS

A WATERSPOUT IN LATITUDE 53° N.

The reproductions on the opposite page are from a small photograph sent us by Mr. Thomas Nunns, of New Westminster, British Columbia. The waterspout occurred at Jackfish Lake, which lies about 8 miles west of North Battleford, Saskatchewan, on July 20, 1923. Mr. Nunn's notes accompanying the photograph are as follows:

Jackfish Lake, about 15 by 7 miles. Waterspout traveled about 14 miles.
Direction, from NW. to SE. across lake, appearing from a wheat field.
Direction from camera, almost direct east.
Approximate distance from camera, about 1 mile.
Waterspout stopped at SE. corner of lake near small island. Caused quite high wave; about 4 feet. Weather very hot and sultry. Two terrific thunderbolts preceded it.

NOTE.—The small picture of the original print, unretouched and on the same scale, is presented to show by comparison the extent to which retouching to remove blemishes has altered the appearance of the waterspout.—*B. M. V.*

DOUBLE ANTISOLAR CORONA BY REFLECTED SUNLIGHT

A double solar corona is not often observed; neither is a corona caused by fog about a reflection of the sun. A specter of the Brocken, or antisolar corona, is apparently more rare. And until I saw a double solar corona about the antisolar point of reflected sunlight I did not know of the existence of such a phenomenon. Yet, once seen, it is quite apparent that such an occurrence is natural when there is bright sunshine, with a calm lake, and a low cloud, in the proper positions.

From about 6:05 to 6:20 a. m. (eastern standard time), September 18, 1925, at Silver Lake, N. H., these conditions existed. A low bank of strato-cumulus cloud was forming over a hill about half a kilometer west, and on this cloud was both direct and reflected sunlight. The silhouette of the hilly west shore of the lake with its pointed pine trees was easily recognizable from a house roof 60 meters above and 300 meters west of the lake. Spanning a point about 18° above my shadow on the trees near by, there appeared the double antisolar corona. Its aspect was like that of a small, hazy double rainbow, with a light area of reddish tinge at the center. To the inner red arc the radius was approximately 5° and to the outer about 8°, as roughly measured with forefinger held at arm's length. At the same time, single and double coronal arcs of about the same size were occasionally visible in the fleeting low clouds passing over the sun. The phenomenon ceased when these clouds in the east became too dense, and did not reappear when the sun shone again, for in the meantime the lake had become rippled again, with the south wind.—*Charles F. Brooks (Clark University), Silver Lake, N. H., September 18, 1925.*

THE NEW IDEAS IN METEOROLOGY

There have been great advances in the science of meteorology during recent years which have completely revolutionized our conception of the structure and mechanism of the atmosphere. Dr. G. C. Simpson devoted his presidential address to section A (mathematics and physics)[1] to a description of the chief of these advances, dividing his address into four parts, each dealing with one of the new ideas on which these advances are based.

(1) *The thermal stratification of the atmosphere.*—By using the idea of entropy, Doctor Simpson showed that the atmosphere can be marked off into nearly horizontal shells which have the peculiar property that air which starts in any one shell can not be transferred to any other shell and remain there in equilibrium unless heat is added or subtracted. Thus, in all atmospheric motion in which heat is neither added nor extracted, the air must travel along the shell in which it started. These shells act like physical restraints to the air, tending to prevent its moving in any but an almost horizontal direction. Occasionally the air contains sufficient water vapor to supply, when it condenses, the heat necessary to pierce the thermal stratification, but these occasions are practically confined to thunderstorms and to the rain squalls in the doldrums. The thermal stratification of the atmosphere prohibits the ascent of warm air at the Equator and descent of cold air at the poles, which has generally been considered to be the cause of the general circulation of the atmosphere, on the analogy of a gigantic hot-water system.

(2) *The mechanism of the atmospheric heat engine.*—The old idea that the energy received from the sun is converted into the energy of winds by the air near the ground being warmed and rising, like the hot air in a chimney, is obviously unsound. The thermal stratification prevents this action in all but exceptional cases. In place of this mechanism a new one is introduced. Masses of air from equatorial regions and from polar regions are brought side by side in middle latitudes. The cold-polar air tends to subside and flow under the warm equatorial air which rises up the flank of the cold wedge which the polar air presents to it. When cold and warm air which were originally side by side react in this way, there is an appreciable lowering of the center of gravity of the two masses taken together. Thus potential energy is released and appears as the energy of winds.

(3) *The significance of surfaces of discontinuity in the atmosphere.*—The surfaces at which relatively cold and warm masses of air meet and slide over each other, as just described, can easily be recognized on meteorological charts and by observations in the upper atmosphere. It is found that nearly all cloud is formed at such surfaces. Doctor Simpson discussed the conditions under which these surfaces of discontinuity can be mainted for long periods, and their significance in weather forecasting.

(4) *The origin and structure of cyclones.*—The recent work of Bjerknes and Exner was described, according to which cyclones are formed where masses of air of polar and equatorial origin are brought together, and readjustment takes place in the manner described above. The old idea of a cyclonic depression being a kind of chimney drawing air in below and delivering it at the top can no longer be held.

These new ideas have had a far-reaching effect on the practical application of meteorology. Instead of the old empirical method of forecasting, the forecaster now has much more knowledge of what may be called the anatomy of a depression. He searches his charts for indications of the surfaces of discontinuity and examines the characteristics of the iar masses to see whether they are of polar or equatorial origin. This has all resulted in greater confidence on the part of the forecaster, a confidence which is frequently justified by remarkably accurate forecasts.

[1] Of the British Association for the Advancement of Science, Southampton meeting, 1925. This abstract reprinted from Nature, August 29, 1925.

METEOROLOGICAL SUMMARY FOR SOUTHERN SOUTH AMERICA

[Reported by Señor J. B. Navarrete, El Salto Observatory, Santiago, Chile. Translation by B. M. V.]

The month of September was rainy, especially during the whole first fortnight.

At the beginning of the increase of solar activity, which began toward the end of August, causing intense hot waves, a violent electrical storm developed about sunrise on the 1st of September over the central zone of Chile; it appeared first off the coast opposite Valparaiso about 2 o'clock in the morning. It passed Santiago about 4, Los Andes about 8, and broke up about midday near Caracoles. The path of the storm was clearly parabolic and in a general sense extended from west to east.

On the following days (2d and 3d) an important low-pressure control dominated the southern part of the continent, and rendered unstable the atmospheric conditions in the southern provinces of Chile.

On the 4th, it rained from Valparaiso to Chiloe, the maximum precipitation, 70 millimeters, being observed at Valdivia.

On the 5th, a large cyclonic depression appeared in the west (coinciding with a maximum of the solar constant); the fall of pressure affected the central and southern zones simultaneously, and caused a violent rain and wind storm from Aconcagua to Valdivia; on the 6th the depression was centered off the island of Mocha. It rained hard from Coquimbo to Chiloe. On the 7th, the center of the depression continued to move toward the southern region, and in the southern provinces rain continued intermittently during the 8th and 9th. As a result, there was a general rise of the rivers.

On the 10th, anticyclonic control was established over southern Chile, with a pressure maximum of 770 millimeters (1,026 mb.) at Valdivia. On the 11th, the center of high pressure moved toward the Argentine, and immediately thereafter took up a position between Cordoba and Buenos Aires.

On the 12th, a new depression overspread the southern region, causing rain, and on the 13th pressure began to rise in the south. The center of high pressure reestablished itself at Valdivia, with a maximum of 771 inches (1,028 mb.).

On the 14th, a great depression appeared in the latitude of Juan Fernandez. On the 15th, it affected the central zone of Chile, causing heavy rains and deep snows in the Cordilleran region, which interrupted trans-Andine traffic. On the 16th the snowstorm continued between Juncal and Bariloche; it rained in the central and southern parts of Chile. On the 17th the depression moved southward, and the rain in central Chile began to decrease.

During the 18th to 20th there was a temporary period of calm, with variable weather.

On the 24th and 25th an important depression caused rain in central and southern Chile; and, finally, between the 26th and 30th, a great anticyclonic center formed over southern South America, reestablishing fine weather.

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SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING SEPTEMBER, 1925

By HERBERT H. KIMBALL, Solar Radiation Investigations

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1924, 52:42 and January, 1925, 53:29.

From Table 1 it is seen that solar radiation measurements averaged below normal for September at Washington, D. C., and close to normal at Madison, Wis., and Lincoln, Nebr.

Table 2 shows that the total solar and sky radiation received on a horizontal surface averaged below the September normal at all three stations.

At Washington skylight polarization measurements made on three days give a mean of 55 per cent, with a maximum of 67 per cent on the 25th. At Madison, measurements made on eight days give a mean of 58 per cent with a maximum of 66 per cent on the 24th. These are close to normal values at Washington but below normal at Madison.

TABLE 1.—*Solar radiation intensities during September, 1925*

[Gram-calories per minute per square centimeter of normal surface]

Washington, D. C.

Date	Sun's zenith distance										
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Sept. 2	11.81				0.86						8.18
3	16.20					1.19					15.65
4	16.79		0.66	0.76							15.65
5	14.10				0.89						12.68
17	14.10			0.45	0.75						12.24
19	16.79		0.49	0.70	0.93						11.38
25	8.48	0.70	0.89	1.06	1.22	1.40					7.57
26	7.57	0.76	0.87								7.87
Means		(0.73)	0.73	0.74	0.93	(1.30)					
Departures		+0.04	−0.02	−0.13	−0.11	−0.02					

[1] Extrapolated.

TABLE 1.—*Solar radiation intensities during September, 1925*—Con.

Madison, Wis.

Date	Sun's zenith distance										
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Sept. 3	16.20				0.92	1.30	1.04				16.79
4	12.68	0.78	0.84	0.88	1.06		0.95				14.00
14	9.14						1.12				8.81
17	14.10				1.01						18.59
21	7.04		1.01	1.11	1.29	1.49					6.50
23	7.57		0.89	1.05	1.22	1.44	1.24				6.76
24	9.14	0.91	1.00	1.12	1.29	1.47					9.83
25	6.27		0.93	0.98							7.87
Means		(0.84)	0.93	1.03	1.13	1.42	1.06				
Departures		−0.04	−0.02	+0.01	−0.03	+0.04	−0.10				

Lincoln, Nebr.

Sept. 2	14.60			0.98	1.17	1.37	1.13	0.91	0.80	0.69	13.13
3	14.10	0.76	0.88	1.00	1.12	1.42	1.18	1.02	0.85	0.76	13.13
4	14.10	0.75	0.86	0.99	1.16	1.39					13.13
12	7.29		1.14	1.19	1.26	1.51					7.04
16	14.60	0.63	0.70								18.59
17	17.37		0.93	1.07	1.22						15.65
18	15.11						1.09	0.90	0.80		17.37
19	16.79	0.87	0.98	1.10	1.24	1.37	0.96				15.65
23	7.04						1.21	1.08	0.89	0.79	7.87
24	8.18	0.80	1.02	1.13	1.31	1.42	1.21	1.05	0.93		10.21
28	12.68	0.76	0.89	1.04	1.22	1.43	1.21	1.04	0.91		14.10
Means		0.76	0.92	1.06	1.21	1.42	1.14	1.00	0.86	0.75	
Departures		±0.00	+0.06	+0.05	+0.01	+0.03	−0.01	+0.03	+0.03	+0.02	

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter of horizontal surface]

Week beginning—	Average daily radiation					Average daily departure from normal		
	Washington	Madison	Lincoln	Chicago	New York	Washington	Madison	Lincoln
1925	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Sept. 3	403	300	403	357	265	+11	−76	−34
10	307	337	328	167	240	−66	−12	−83
17	334	381	354	289	312	−26	+54	−36
24	346	256	319	246	314	−1	−50	−51
Excess or deficiency since first of year on September 30						+1,561	+1,645	−721

WEATHER OF NORTH AMERICA AND ADJACENT OCEANS

NORTH ATLANTIC OCEAN

By F. A. YOUNG

The following table shows the average sea-level pressure for the month, as well as the highest and lowest barometric readings, at a number of land stations on the coast and islands of the North Atlantic. The readings are for 8 a. m. seventy-fifth meridian time, and the departures are only approximate, as the normals were taken from the Pilot Chart and are based on Greenwich mean noon observations, which correspond to those taken at 7 a. m., seventy-fifth meridian time.

Station	Average pressure	Departure	Highest	Date	Lowest	Date
	Inches	*Inches*	*Inches*		*Inches*	
St. Johns, Newfoundland	29.88	−0.12	30.22	Sept. 27	29.42	Sept. 26
Nantucket	30.04	0.00	30.52	Sept. 26	29.66	Sept. 21
Hatteras	30.03	0.00	30.40	Sept. 27	29.78	Sept. 4
Key West	29.97	+0.01	30.06	Sept. 28	29.90	Sept. 15
New Orleans	30.00	+0.02	30.14	Sept. 28	29.86	Sept. 25
Swan Island	29.82	−0.07	29.90	[1] Sept. 2	29.74	[1] Sept. 15
Turks Island	29.98	−0.05	30.06	[1] Sept. 10	29.92	[1] Sept. 21
Bermuda	30.08	+0.03	30.40	Sept. 27	29.80	Sept. 20
Horta, Azores	30.16	−0.01	30.46	Sept. 26	29.92	[1] Sept. 11
Lerwick, Shetland Islands	29.75	−0.09	30.20	[1] Sept. 12	28.87	Sept. 20
Valencia, Ireland	30.03	+0.04	30.39	Sept. 27	29.06	Sept. 22
London	29.98	−0.03	30.41	Sept. 13	29.31	Sept. 19

[1] And on other dates.

Over the middle and eastern section of the steamer lanes the number of days with winds of gale force did not differ materially from the normal as shown on the Pilot Chart. West of the fiftieth meridian gales were not reported on more than one day in any five-degree square, and the American coast was apparently practically free from heavy weather.

Fog was again unusually prevalent during the month, especially over the region between the fortieth and fiftieth parallels, west of the forty-fifth meridian, where it was reported on from 8 to 14 days. It also occurred on from 4 to 9 days over the eastern section of the steamer lanes, and somewhat less frequently off the north coast of Ireland, while the air was comparatively clear over the remainder of the British Isles and continental Europe.

On the 1st there were two comparatively shallow depressions over the ocean; the first central near Father Point, Quebec, and the second off the north coast of Scotland. On the 2d the first LOW was near St. Johns, Newfoundland, and the second over the North Sea. Moderate gales were reported on both of these days near the respective centers, while moderate weather prevailed over the remainder of the ocean.

From the 3d to the 10th unusually favorable conditions prevailed over the entire ocean, except that in the evening of the 5th there was a severe squall in the Gulf of Mexico, and also easterly winds of gale force near 40° N., 56° W., while on the 7th St. Johns, Newfoundland, with a barometric reading of 29.54 inches, was near the center of a well-defined depression, southerly winds of force 7 being reported from the easterly quadrants. On the 11th moderate weather continued, except in the vicinity of the Azores, where there was a LOW accompanied by moderate gales, as shown by report in table from Norwegian S. S. *Conrad Mohr*. This LOW moved but little during the next 48 hours, with the weather conditions practically unchanged. On the 12th a second disturbance developed near 51° N., 32° W., accompanied by gales between the center and European coast, north of the fifty-fifth parallel.

Charts VIII to X show the conditions from the 14th to 16th, inclusive, during which period a disturbance that reached its greatest intensity on the 15th prevailed over the eastern section of the steamer lanes.

The American S. S. *Clearwater*, Capt. John D. Pearson; observer, Robert J. Ernst, from New Orleans to Para, Brazil, encountered on the 14th in 9° 30′ N., 50° W., heavy rain squalls from the east with wind force 7 to 9.

On the 17th and 18th moderate weather was the rule over the ocean as a whole.

On the 19th there was one depression near St. Johns, Newfoundland, and a second over the English Channel. The western disturbance developed into one of the most severe of the month, as shown by Charts XI to XIII, for the period from the 20th to 22d, inclusive. From the 23d to 25th moderate weather was general, except that on the 23d and 24th westerly gales were reported from a restricted area over the eastern section of the steamer lanes, and on the 25th there was a LOW over Newfoundland that afterwards developed into a severe disturbance. On the 26th this LOW was central near 52° N., 53° W., and westerly to northwesterly gales occurred over an extensive region between the fortieth and fifty-fifth parallels and fortieth and sixty-fifth meridians. On the same date winds of moderate gale force were also reported by land stations on the British coast and by vessels in the English Channel.

By the 27th the western disturbance had diminished both in extent and intensity and moderate weather prevailed until the end of the month, except in limited areas over the middle and eastern section of the steamer lanes, where westerly and southwesterly gales were reported on the 29th and 30th.

Ocean gales and storms, September, 1925

Vessel	Voyage		Position at time of lowest barometer		Gale began	Time of lowest barometer	Gale ended	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Highest force of wind and direction	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				*Inches*					
Saxoleine, Br. S. S.	England	New Orleans	57 26 N.	11 14 W.	1st	12.30 a.	1st	29.80	W	W., 8	W	W., 8	Steady.
Parthenia, Br. S. S.	Montreal	Glasgow	53 34 N.	48 31 W.	2d	4 p., 2d	3d	29.75	S	S., 9	S	S., 9	Do.
Baja California, Hond. S. S.	New Orleans	Vera Cruz and return.	22 52 N.	93 35 W.	5th	6 p., 5th	6th	29.77	N	N., 4	SE	E., 8	N.-E.-SE.
Coldbrook, Am. S. S.	do	Havre	41 27 N.	52 55 W.	5th	9 p., 5th	10 p., 5th.	29.57	ENE.	NE., 9	NE	NE., 9	ENE.-NE.
Conrad Mohr, Nor. S. S.	do	Marseille	37 35 N.	24 48 W.	10th	10 a., 12th	13th	29.87	SE	SE., 7	SE	—, 8	Steady.
Baron Wemyss, Br. S. S.	Quebec	Greenock	55 54 N.	33 30 W.	11th	2a., 12th	13th	29.50	NE	N., 9	WSW	N., 9	NE.-N.
Do	do	do	56 10 N.	13 27 W.	14th	5p., 15th	15th	29.32	S	Calm	NW	S., 10	S.-Calm.-SW.-NW.
Lwow, Pol. Bk.	Cadiz	Rotterdam	48 45 N.	11 35 W.	14th	7a., 14th	15th	29.42	SSE	SSE., 6	WSW	SW., 10	
United States, Dan. S. S.	Oslo	New York	58 33 N.	17 35 W.	15th	10 a., 15th	18th	29.36	SSE	SSE., 7	W	WNW., 9	SSE.-WNW.
George Washington, Nor. M. S.	do	Canal Zone	45 09 N.	12 55 W.	18th	8 p., 18th	19th	29.55	WNW.	S., 9	NW	SW., 11	S.-W.-N.
Lwow, Pol. Bk.	Cadiz	Rotterdam	50 36 N.	3 00 W.	19th	6a., 19th	19th	29.26	ESE.	SW	WSW	SW., 10	ESE.-S.-WSW
Munchen, Ger. S. S.	New York	Cherbourg	45 36 N.	40 19 W.	18th	Mid., 19th	23d	29.51	SW	WSW., 10	NNW	WNW., 11	SW.-W.
Paris, Fr. S. S.	Havre	New York	48 10 N.	43 45 W.	19th	2a., 20th	11 a., 20th.	29.25	S	W., 10	WNW	W., 11	SW.-W.
Stockholm, Swed. S. S.	New York	Gothenburg	58 02 N.	5 18 E.	19th	—, 20th	20th	29.12	ESE.	SE., 8		SE., 9	ESE.-SSE.
Caronia, Br. S. S.	London	New York	49 38 N.	20 10 W.	21st	4 p., 21st	22d	29.24	W	W., 9	NW	—, 10	SSE.-W.-NNW.
Nubian, Br. S. S.	Liverpool	Philadelphia	50 39 N.	20 14 W.	21st	Mid., 21st	22d	28.94	SSE.	WNW., 10	NNW	—, 12	W S W.-W.-WNW.
Vittorio Emanuele III, Am. S. S.	Ireland	Baltimore	52 37 N.	35 29 W.	21st	4 p., 21st	23d	29.35	NW	NW	SW	NW., 9	WNW.-SW.
Hoosac, Br. S. S.	Norfolk	Liverpool	51 36 N.	17 45 W.	21st	4 a., 22d	23d	29.09	SE.	NW., 10	NW	NW., 11	
Persephone, Danz. M. S.	Hamburg	Sabine	49 30 N.	7 00 W.	22d	5 p., 22d	22d	29.06	SW	SW., 10	NW	SW., 10	SW.-W.-NW.
Aral, Br. S. S.	Leith	New York	55 03 N.	31 00 W.	23d	8 p., 23d	24th	29.36	SSE.	S., 8	W	—, 9	SSE.-S.-W.
De Grasse, Fr. S. S.	Havre	do	44 46 N.	56 20 W.	25th	11 p., 25th	26th	29.72	SW	NW., 5	NW	NNW., 9	SW.-NW.
Nubian, Br. S. S.	Liverpool	Philadelphia	46 07 N.	41 42 W.	26th	Noon, 26th	26th	29.74	SW	SW., 9	W	—, 9	SW.-W.
Winnebago, Br. S. S.	London	Brunswick, Ga.	50 12 N.	44 10 W.	28th	4 a., 29th	29th	29.68	SW	SW., 9	WSW	SW., 9	SW.-WSW.
Casper, Am. S. S.	Copenhagen	Norfolk	54 25 N.	35 00 W.	28th	2 p., 29th	30th	29.73	SW	SW., 9	W	SW., 9	SW.-NW.-W.
NORTH PACIFIC OCEAN													
Boren, Swed. S. S.	Philippine Islands.	San Francisco.	17 23 N.	135 32 E.	Aug. 31	5 p., 1st	Sept. 2	29.12	N	S., 10	S	S., 10	N.-W.-S.
Steelmaker, Am. S. S.	Honolulu	Iloilo, P. I.	18 14 N.	144 15 E.	1st	4 p., 1st	4th	29.55	SSE	SSW	SW	SW., 7	S.-SW.
Salina, Am. S. S.	Los Angeles	Manila	22 03 N.	133 28 E.	2d	4 p., 4th	4th	29.45	SSE	S., 7	S	S., 8	SSE.-S.
Teucer, Br. S. S.	Japan	Hankow	31 24 N.	129 00 E.	5th	6 p., 6th	7th	29.40	ESE.	S., 11	W	S., 11	S.-W.
President Hayes, Am. S. S.	San Francisco.	Kobe	33 28 N.	128 50 E.	6th	2 a., 7th	7th	28.84	SE.	SSE., 12	WNW	SE., 12	SE.-S.-SW.
M. H. Whittier, Am. S. S.	Iquique	San Pedro	See text.		8th		9th	[1]29.75	SW		SW	SW., 12	
Do	do	do	See text.		12th	6 a., 14th	14th	[1]29.44	SW	SW., 11	SW	SW., 11	
Edgemoor, Am. S. S.	San Francisco.	Balboa	8 05 N.	85 15 W.	13th	10 p., 13th	14th	29.54	ENE.	ENE., 8	SE	ENE., 8	ENE.-ESE.
Betterton, Am. S. S.	do	Iquique	[2]16 09 N.	105 30 W.	14th	5 a.	14th	29.51		SW., 8		SW., 8	
China Arrow, Am. S. S.	Shanghai	San Francisco.	40 38 N.	125 00 W.	12th	16th	16th	29.58	NNW.	SE., 8	SE	SE., 8	SE.-SSW.
Waitemata, Br. S. S.	Auckland	Vancouver	44 07 N.	130 18 W.	15th	8 a., 16th	16th	[1]29.27	WNW.	NW	NNE	NW., 9	WNW.-NW.
Java Arrow, Am. S. S.	San Pedro	Woosung	31 07 N.	124 40 W.	16th	8 a., 17th	17th	29.71	SE.	N., 8	N	NE., 9	NE.-NW.
Havre Maru, Jap. S. S.	Yokohama	San Francisco.	41 40 N.	132 50 W.	16th	1 a., 17th	17th	[1]29.71	NW	NNW., 9	NNW	NNW., 9	Steady.
Pioneer, U. S. S.	Cruising in Alaskan waters.		54 57 N.	162 25 W.	17th	6 a., 19th	21st	29.08	E	S., 1	NW	NW., 10	SE.-S.
West Nomentum, Am. S. S.	Japan	San Francisco.	49 00 N.	168 00 E.	18th	Mid. 18th.	19th	29.50	N	NNW., 9	NNW	NNW., 9	Steady.
West Jessup, Am. S. S.	Portland	Yokohama	50 00 N.	172 40 E.	18th	8 p., 18th	19th	29.04	NNW.	NW	NNW	NNW., 10	NW.-N.
Africa Maru, Jap. S. S.	Yokohama	Victoria	41 15 N.	153 00 E.	18th	4 a., 19th	20th	29.97	ENE.	ESE., 8	SSE	SE., 8	E.-SE.
West Sequana, Am. S. S.	Manila	San Francisco.	41 15 N.	167 35 E.	28th	4 a., 29th	30th	29.46	W	W., 8	W	W., 8	Steady.
West Jena, Am. S. S.	Kobe	Portland	31 48 N.	138 00 E.	29th	11 p., 30th	Oct. 1	29.13	E	S., 12	WNW	S., 12	SE.-S.-SW.
SOUTH PACIFIC OCEAN													
Eastern Moon, Am. S. S.	Panama	Sydney, Australia.	31 20 S.	171 50 E.	Aug. 31	3 p., 1st	Sept. 1	29.35	NNW.	W., 7	SSE	NW., 9	NW.-SW.
SOUTH ATLANTIC OCEAN													
Nairnbank, Br. S. S.	Texas	Cape Town	33 54 S.	17 45 E.	9th	4 p.	9th	29.88	NW	NW., 9	NW	NW., 9	Steady.
Lorraine Cross, Am. S. S.	Buenos Aires	New Orleans	29 56 S.	48 16 W.	22d	22d	23d	29.88	NE.	NE., 8	WNW	NW., 8	NE.-N.

[1] Reading uncorrected.

[2] Regular observation only.

NORTH PACIFIC OCEAN

By WILLIS EDWIN HURD

A considerable change from the general atmospheric sluggishness of August occurred during September. The great anticyclone of the eastern Pacific, which had persisted for several months with very little disintegration, continued to be fairly well established, though its average pressure was lower than normal. However, cyclonic activities without, and incipient depressions within, its area indicated that brisker and more unstable conditions were in operation.

In higher latitudes several active cyclones moved eastward over the Aleutians, the adjoining waters, and Alaska. They occurred principally during the second decade, and lacked the fluctuating characteristics of the average LOW of the region. For the month the pressure over this portion of the sea was considerably above the normal.

Cyclones formed and moved more freely over middle and higher latitudes, and thus gales became more fre-

quent, and the surface air greatly cleared. Consequently fog decreased rapidly from August along the steamship routes, but increased in Alaskan waters, where reports indicate a far greater prevalence than usual. Fog continued relatively frequent along our western coast.

The following table shows the atmospheric pressures for several island and coast stations for September. It will be observed that a rather abnormal gradient existed between Juneau, with a plus pressure departure of 0.17 inch, and Tatoosh Island, with a minus departure of 0.03 inch.

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
Dutch Harbor [1]	(2)	(2)	(2)	(2)	(2)	(2)
St. Paul [1]	[3] 29.84	+0.14	30.26	[4] 8th.	28.98	18th
Kodiak [1]	[3] 29.97	+0.27	30.42	24th	29.18	20th
Midway Island [1]	[5] 29.96	−0.11	30.08	18th	29.82	9th
Honolulu [7]	29.97	−0.03	30.07	16th	29.84	9th
Juneau [7]	30.07	+0.17	30.38	28th	29.60	14th
Tatoosh Island [8]	29.98	−0.03	30.19	30th	29.49	16th
San Francisco [8]	29.93	−0.01	30.21	29th	29.76	16th
San Diego [8]	29.88	0.00	30.04	7th	29.71	14th

[1] P. m. observations only.
[2] Data insufficient.
[3] 25 days.
[4] And other dates.
[5] 26 days.
[6] 27 days.
[7] A. m. and p. m. observations.
[8] Corrected to 24-hour mean.

East winds continued to prevail at Honolulu, and kona winds occurred infrequently. The average velocity was 8.8 miles per hour; the maximum velocity, 30 miles NE. on the 29th. Rainfall continued to be less than the normal.

Tropical cyclones in both east and west longitudes were moderately frequent and of dangerous strength. The following article by the Rev. José Coronas, S. J., of the Manila Observatory, describes the movements of such typhoons as occurred in the Far East up to and including September 18. In addition to the steamers mentioned in that report as being heavily involved in the typhoon south of Korea on the 6th, a special report from the British steamer *Teucer* shows that this vessel experienced considerable difficulty in crossing the Yellow Sea from western Japan to the Yangtse River. The captain intended sailing along the northern edge of the storm on the 5th and thus cut ahead of the approaching center, favored by the fresh easterly winds. In the evening, however, he decided this could not be done, and the *Teucer* was headed S. 15° E. at 10 p. m. Throughout the 6th she steamed against the generally southerly winds, encountering gales of force 11, but escaping the storm center. At midnight of the 6th she was able to resume her course in winds that were rapidly hauling to SW. Press reports indicate considerable damage to life and property in Korea resulting from this storm.

A further press report speaks of an intense storm, accompanied by "the worst floods Japan has experienced in 50 years," which swept the Empire, especially the central districts, during the night of the 30th. Our maps show a considerable depression nearing southern Japan on the morning of the 30th, and near Tokyo 24 hours later. From the 28th to the 30th the American steamer *West Jena*, from Kobe, experienced the strong to hurricane winds of this typhoon, which delayed her within the area bounded by 31° to 34° N., 135° to 138° E. for more than 48 hours.

From the American Tropics come various reports of severe storms this month. On the 8th and 9th the American steamer *Mericos H. Whittier*, Iquique to San Pedro, encountered a SSW. to SW. storm of exceptional violence for the region so far south, the vessel being in 4° 23′ N., 92° 13′ W. at 6 a. m. of the 8th. During that day heavy rain squalls, with winds sometimes attaining force 12, were experienced. The gales continued until the 9th, generally from the SW., lowest given pressure, 29.75 (uncorrected), at 6 a. m. of the 9th.

The *Mericos H. Whittier* again encountered SW. gales on the 12th. These continued until the afternoon of the 14th, but rose to force 11 at 4 p. m. of the 13th, pressure falling to 29.44 (uncorrected), at 6 a. m. of the 14th. Unfortunately the vessel did not record its positions during this storm, but from the dates given, taken in conjunction with its earlier and subsequent known positions, it must have experienced the same cyclone that was encountered by the American steamer *Betterton*, on the 14th, in 16° 09′ N., 105° 30′ W. The disturbance reported by the American steamer *Edgemoor* on the 13th, in 8° 05′ N., 85° 15′ W. (see table), seems hardly to have been identical with the previously mentioned storm of the same date, though further information may connect the two.

A shipping report from the American steamer *West Calera*, which left San Pedro on the 21st, bound for Sydney, Australia, states that this vessel, when 1,832 miles from the sailing port, on the 29th, encountered a severe hurricane. No further data concerning the storm are available at this writing.

Waterspout.—American steamer *Enterprise*, San Francisco toward Hilo: "September 13, 1925. In 35° 18′ N., 128° 03′ W., at 5.58 p. m., passed waterspout about 40 feet high traveling NE. 20 miles per hour."

DUST OVER INDIAN OCEAN

Reports of dust at sea come from the following vessels: American steamer *Egremont*, 13° 32′ N., 43° E. (southern part of Red Sea); 7th: "Thick sand." American steamer *President Harrison:* "9th, at 9 p. m. When passing Aden 10 miles distant encountered a slight sandstorm, or at least for 30 minutes in cloud of dust. Very little breeze from off shore."—*W. E. H.*

THREE WELL-DEVELOPED TYPHOONS IN THE FAR EAST DURING SEPTEMBER 1 TO 18

By Rev. José Coronas, S. J.
[Weather Bureau, Manila, P. I.]

Our weather maps showed three well-developed typhoons in the Far East during the first half of the month. At the time we are writing this (Sept. 25) there is another big typhoon over 300 miles to the east of central Luzon moving WNW. The U. S. Army transport *Thomas* and the U. S. Navy transport *Chaumont* are well under the influence of this typhoon in their way from Guam to Manila. Details concerning this typhoon will be given in our article for next month.

The first typhoon of this month of September had formed already on August 27 to 28 over the western Carolines to the south of Guam, near 145° longitude E. and 10° latitude N. It moved first NNW. and almost north until the early morning of the 30th, passing near Guam to the west in the evening of the 29th. The barometric minimum observed there was 740 mm. (29.13 inches) at 7 p. m., a gale blowing from the E. and SE. quadrants.

On the 30th and 31st of August the typhoon moved WNW. and W. by N., but on September 1 it inclined again northward, keeping a NW. and NNW. direction

until the early morning of the 6th, when it recurved northeastward in the northern part of the Eastern Sea. The center of the typhoon traversed the Korea Strait and the southeastern part of Korea during the night of the 6th to 7th, and the Japan Sea on the 7th.

The rate of progress of the typhoon was only of 6 or 6.5 miles per hour from September 1 to 4. The positions of the center at 6 a. m. of these four days were as follows:

September 1, 6 a. m., 18° 30′ latitude N., 135° 00′ longitude E.
September 2, 6 a. m., 20° latitude N., 133° 15′ longitude E.
September 3, 6 a. m., 21° 50′ latitude N., 131° 40′ longitude E.
September 4, 6 a. m., 23° 35′ latitude N., 130° 05′ longitude E.

The center passed very close to the north of Naha in the early morning of the 6th, the barometer of that station being as low as 722 mm. (28.43 inches) at 6 a. m. of that day. The steamers *Madras Maru*, *Empress of Russia*, and *President Hayes* were much involved in this typhoon on September 6 in the Korea Strait and in the Eastern Sea.

The second typhoon of September appeared on the 3d to 5th to the NNE. of Guam, near 149° longitude E. and 19° latitude N. It moved WNW. on the 5th and northward after the 5th. It passed near to the east of the Bonins on the 8th and filled up on the 9th not far from 142° longitude E. and 30° latitude N.

The third typhoon was shown by our weather maps on the 10th to 11th between 127° and 128° longitude E., 18° and 19° latitude N. It moved westward on the 12th, and inclined very much to the north on the 13th, at the same time decreasing considerably its rate of progress. The center passed very near to the east of Basco in the morning of the 14th. From the Bashi Channel the typhoon moved NNW. toward the northern part of Formosa increasing again its rate of progress. The steamer *President Pierce* met the typhoon north of Formosa in about 121° longitude E., 26° 30′ latitude N., her barometric minimum having been 742.44 mm. (29.23 inches) at 1.30 a. m., with hurricane winds from NW. by N. According to one of the officers of the steamer relative calm was observed for about 20 minutes at the time of the barometric minimum.

The typhoon began to move NE. after traversing the northern part of Formosa, and it inclined still more to the E. on the 17th. At 6 a. m. of the 18th the center was situated south of Japan, in about 133° 20′ longitude E. and 31° 40′ latitude N. It is impossible with the data at hand to follow the typhoon further.

TWO SEVERE TYPHOONS OVER THE NORTHERNMOST PART OF THE PHILIPPINES IN JULY, 1925

By Rev. José CORONAS, S. J.
[Weather Bureau, Manila, P. I.]

Two well-developed typhoons have visited the Philippines during this month, with an interval between the two of only five days. The first passed over or very close to the Batanes Islands on the 8th, and the second touched the northeastern end of Luzon on the 13th. The second was much more severe than the first, but fortunately it struck only the northeastern end of Luzon in a northwesterly direction, thus averting for the northern part of Luzon a much-feared destruction. Great damage, however, was done by the two typhoons in a good number of provinces through heavy rains and floods.

The first typhoon appeared for the first time in our weather maps on July 3, the center being approximately situated then over the western Carolines near 8° latitude N., between 142° and 143° longitude E. It moved NW. to the northeast of Yap, until the afternoon of the 4th when it began to incline westward. On the 5th the typhoon was moving W. by N., threatening the northern coast of Luzon; but it inclined again to NW. on the 6th, and even to NNW. on the 7th in the direction of Formosa. The barometric minimum observed in Basco, Batanes Islands, was 737.38 mm. (29.03 ins.) at 6.30 a. m. of the 8th. The U. S. Navy transport *Chaumont* was well under the influence of this typhoon on her trip from Guam to Manila, July 3 to 5.

The steamship *Calcutta Maru*, on her way from Kobe to Iloilo, was also within the body of this typhoon on the 6th to 8th, when near 128° longitude E. and 20° latitude N., the barometer having fallen to 747.51 mm. (29.43 ins.) on the 7th, with a gale blowing from the E., SE., and S.

The typhoon entered China on the 9th between 119° and 120° longitude E., 25° and 26° latitude N.; it recurved northeastward on the 11th to the west and northwest of Shanghai, and traversed Korea, moving ENE. in the early morning of the 12th.

The steamship *President Grant* was somewhat involved in this typhoon between Shanghai and Formosa on her last trip from Shanghai to Manila, July 10 and 11.

The approximate position of the center at 6 a. m. of July 5 to 12 was as follows:

July 5, 6 a. m., 134° 30′ Longitude E., 14° 50′ Latitude N.
July 6, 6 a. m., 129° Longitude E., 16° 30′ Latitude N.
July 7, 6 a. m., 124° 35′ Longitude E., 18° 30′ Latitude N.
July 8, 6 a. m., 122° 40′ Longitude E., 20° 30′ Latitude N.
July 9, 6 a. m., 120° 05′ Longitude E., 24° 30′ Latitude N.
July 10, 6 a. m., 119° Longitude E., 26° 40′ Latitude N.
July 11, 6 a. m., 119° Longitude E., 32° 10′ Latitude N.
July 12, 6 a. m., 127° 35′ Longitude E., 37° 45′ Latitude N.

The second typhoon made its appearance at 6 a. m. of the 8th, when the preceding one was still over the Philippines. Its center was situated over the western Carolines to the south of Guam about 145° longitude E. and near 10° latitude N. It moved WNW. on the 8th and 9th, but inclined westward on the 10th. The U. S. Army transport *Thomas* was well involved in this typhoon on her way from Guam to Manila; and the motor *Elmbank*, on her voyage from San Pedro to Manila, met the real center of this typhoon in 127° 25′ longitude E. and 14° 54′ latitude N, her barometer having fallen to 28.12 inches (714.25 millimeters) at 8 p. m. of the 11th, with terrific hurricane winds that backed very quickly from NNE. to W., S. and SSE. Relative calm was observed at 7.15 p. m. As we have only barometric observations taken every hour, the exact minimum, which must have occurred between 7 and 8 p. m., is not known.

In the afternoon of the 11th the typhoon took a northwesterly direction toward the northeastern end of Luzon when it was met by the steamship *Pathfinder* at 4.25 a. m. of the 13th with a barometric minimum as low as 28.05 inches (712.47 millimeters), 5 minutes calm having been observed, broken by an occasional gust at 3.40 a. m. The steamer was anchored at Port San Vicente (122° 09′ longitude E, 18° 31′ latitude N.). From northeast Luzon the typhoon moved to NNW., its center being situated, at 6 a. m. of the 14th, over the southern part of the Formosa Channel.

The approximate positions of the center at 6 a. m. for the period July 9 to 14 were as follows:

July 9, 6 a. m., 141° 50′ longitude E, 11° 30′ latitude N.
July 10, 6 a. m., 135° 40′ longitude E, 13° 30′ latitude N.
July 11, 6 a. m., 129° 45′ longitude E, 14° 25′ latitude N.
July 12, 6 a. m., 125° 30′ longitude E, 15° 45′ latitude N.
July 13, 6 a. m., 121° 50′ longitude E, 18° 50′ latitude N.
July 14, 6 a. m., 118° 15′ longitude E, 23° 20′ latitude N.

DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

The single outstanding feature of the month was the sharply contrasted distribution of temperature and precipitation in the various sections of the country.

These contrasts are traceable to the prevalence of two different types of pressure distribution; the first, which prevailed until about the 20th, favored the free movement of cyclonic systems along the average path; the second was practically the reverse, since anticyclones that originated in the North Pacific and Alaska progressed almost in a due-east direction over Canada and the northern part of the United States rather than from northwest to southeast. Pressure in the North Pacific HIGH was somewhat below the normal.—*A. J. H.*

CYCLONES AND ANTICYCLONES

By W. P. DAY

With the exception of a small tropical disturbance, which caused moderately high winds and heavy rain over the lower Rio Grande on the night of the 6th–7th, low-pressure areas were generally ill defined and of slight barometric gradient until the 19th, when a rather important storm area developed over the northern Rocky Mountain region and moved eastward. High-pressure areas were likewise unimportant until the last decade. Near the beginning of this period pressure began rising over the Aleutian Islands. This HIGH developed and spread eastward over the Gulf of Alaska and into the interior of Alaska and then into Canada and by the end of the month a great area of high pressure covered much of Canada, Alaska, and the northern portion of the United States. Due, however, to the oceanic origin of this HIGH there was no important depression of temperature associated with it.

FREE AIR SUMMARY

By V. E. JAKL

The principal feature of upper-air temperature averages for the month was a general well-pronounced excess at all stations as compared with the normal. (See Table 1.) It was most pronounced over Due West, and showed no well-defined variation with altitude; therefore the surface departures, as shown in Chart III of this REVIEW, fairly well represent the distribution of the free-air departures also. Notwithstanding this general excess in temperature, relative humidities averaged about normal, indicating a generally greater moisture content of the air than is usual for the time of year.

Resultant free-air winds were, with few exceptions, southwesterly, becoming westerly at 4,000 meters and above. The principal exception was at Key West, where winds were practically due east at all levels observed. Easterly winds aloft were of infrequent occurrence over mid-continental stations, although they were persistent over the southern Plains States during the first few days of the month, of which good examples are shown in the kite and pilot balloon observations at Groesback on the 1st, and the two-theodolite pilot balloon observation at Broken Arrow on the 2d. In the former observation, nearly due-east winds were recorded from the ground to about 7,000 meters, and in the latter, southerly winds in the lower levels backed to easterly at 8,000 meters, remaining due east thence to 12,000 meters.

Weak high pressure covered the greater portion of the country during this period. The principal instance of easterly wind to high altitudes over northern stations occurred at Ellendale on the 22d, when a two-theodolite observation showed westerly winds near the ground, veering with altitude and becoming northeasterly from 6,000 to 9,000 meters. On this date a ridge of moderately high pressure overlay the northern portion of the country, Ellendale lying along its northern border.

Comparing the resultant winds with the normal, it is found that the deviations were on the whole slight (see Table 2), being apparent principally at Groesbeck, where the resultants showed south-southwest at all altitudes, as compared with slightly east of south for normal. Wind resultants from kite observations at Due West are based on too few observations to be reliable, but balloon observations at that station showed more definitely that the winds were principally northwesterly at all altitudes, except that in the lowest 500 meters the wind changed from prevailing northeasterly in the morning to northwesterly in the afternoon. The abnormally high temperatures at Due West were therefore associated with winds of continental (presumably near by) origin both at the surface and aloft. This is particularly shown in connection with the maximum temperature for the month, 105° on the 8th, which was accompanied by light northwesterly winds to 4,000 meters, becoming westerly at 5,000 meters.

The following record of the upper-air observation at Ellendale on the 4th, and comments of the official in charge relative thereto, is descriptive of the conditions attending a kite flight made immediately preceding a thunderstorm of the "wind shift line" type. The stratus approaching from the northwest when the winds aloft were still from directions ranging from east to south with altitude, apparently represented the top of the turbulent column of the approaching "cold front."

Surface wind became northwest soon after the flight.

"During the latter half of the flight of the 4th severe thunderstorm conditions developed. Storms were located to the south and northwest of the station. The storm to the northwest seemed to develop very rapidly. Wind directions aloft shifted from south to east within the range of altitude from 1,500 meters down to the ground. A thin line of stratus clouds was observed to be moving from the northwest before landing the head kite. When close enough to be more carefully observed it was noted that a violent rolling motion was present. A maximum surface wind of 58 miles an hour from the northwest was recorded at 2:18 p. m., with a light but rapid fall of rain."

Time, p. m.	Altitude, m. s. l.	Temperatures	$\frac{\Delta t}{100\ m.}$	Relative humidity	Wind direction	Wind velocity
	Meters	*° C.*		*Per cent*		
12:43	4,941	−5.0	0.41	49	S.	15
12:55	4,573	−3.5	.34	92	S.	14
1:00	4,515	−3.3	.62	74	S.	14
1:04	4,288	−1.9	.77	94	S.	13
1:33	3,078	7.4	.71	80	S.	15
1:40	1,951	15.4	.96	53	S.	16
1:52	1,152	23.1	.75	45	ESE.	14
2:01	[1] 444	28.4	----------	48	ESE.	5

[1] Surface.

The following record of the kite flight at Groesbeck on the 24th, including an excerpt from the report of the official in charge, shows upper-air conditions at that sta-

tion attending the development of a LOW in the southwest. An abrupt shift from northerly to southwesterly evidently took place just above the point where the wind movement was reduced to almost a calm at 2,266 meters, as subsequent pilot balloon and cloud observations showed a southwesterly drift at and above that altitude. The alignment of the LOW was NE. to SW., showing that at the place of observation the winds were in agreement with the surface gradient direction in the lower levels, and opposite thereto in the upper levels. "The flight of the 24th was made in a typical "norther" condition at this station. A general rain began falling shortly after the completion of the flight and continued during the greater part of the day."

Altitude, m. s. l.	Temperature	Relative humidity	Wind direction	Wind velocity
Meters	*° C.*	*Per cent*		
2,266	9.7	100	N.	1
1,070	15.7	70	N.	15
820	17.1	65	N.	14
697	15.1	100	NNE.	14
[1] 141	20.0	86	NNE.	5

[1] Surface.

An illustration of the varied changes in wind velocity with height is shown by the pilot balloon records at Burlington on the 20th and 25th. On the 20th Burlington was in a region of strong pressure gradient in front of a pronounced LOW. The wind increased from 19 m. p. s. from the south on the ground to 31 m. p. s. from the south-southwest at 500 meters above ground, diminishing thence to 19 m. p. s. from the west-southwest at 1,000 meters. On the 25th, in the front portion of a HIGH with a pronounced LOW to the east, the wind increased steadily and quite uniformly with altitude from 3 m. p. s. from the north near the ground to 31 m. p. s. from the north-northwest at 3,700 meters. On the 20th, the increase from the ground to 500 meters represented the normal increase with altitude depending on surface friction and turbulence, while the abrupt fall in velocity thereafter with its attendant large change in direction can be attributed to change in pressure gradient with height. On the 25th, the gradual increase in velocity was due to a gradual increase in slope of pressure gradient with altitude. This latter is characteristic of the vertical wind structure to the rear of—and just outside the scope of the surface isobars of—a vigorous LOW. Another type of wind structure with altitude is shown by the two-theodolite pilot balloon observation at Ellendale on the 17th, taken in the rear of a moderate low pressure area. In this observation the wind rose from 3 m. p. s. from the northwest on the ground to 23 m. p. s. at 1,000 meters above ground from the same direction, fell abruptly to 6 m. p. s. from the west at 2,600 meters, and rose rapidly to 38 m. p. s. from the west-southwest at 4,500 meters. In this observation the first rapid increase in velocity was largely a "nocturnal inversion" effect, while the succeeding changes in velocity and direction with altitude were caused by changing direction and steepness of pressure gradient.

TABLE 1.—*Free-air temperatures, relative humidities and vapor pressure during September, 1925*

TEMPERATURE (°C.)

Altitude m. s. l. (*meters*)	Broken Arrow, Okla. (233 *meters*)		Drexel, Nebr. (396 *meters*)		Due West, S. C. (217 *meters*)		Ellendale, N. Dak. (444 *meters*)		Groesbeck, Tex. (141 *meters*)		Royal Center, Ind. (225 *meters*)	
	Mean	Departure from 8-yr. mean	Mean	Departure from 10-yr. mean	Mean	Departure from 5-yr. mean	Mean	Departure from 8-yr. mean	Mean	Departure from 7-yr. mean	Mean	Departure from 8-yr. mean
Surface	26.2	+2.8	20.4	+1.7	27.4	+3.5	16.1	+1.2	25.7	+1.3	22.0	+0.8
250	26.2	+3.0			27.0	+3.5			24.9	+1.1	21.7	+0.7
500	25.8	+4.1	20.1	+1.8	24.9	+3.8	15.8	+0.9	22.9	+0.6	19.9	+1.1
750	24.8	+4.3	19.6	+2.3	23.4	+4.0	15.1	+0.8	21.5	+0.6	18.8	+1.6
1,000	23.3	+4.1	18.9	+2.6	22.2	+4.0	14.6	+1.1	20.8	+1.1	17.5	+1.8
1,250	21.8	+3.9	18.1	+2.8	20.8	+3.8	13.4	+0.8	19.9	+1.4	16.2	+2.0
1,500	20.1	+3.5	16.8	+2.7	19.2	+3.5	12.4	+0.9	18.9	+1.5	15.1	+2.3
2,000	16.9	+2.9	13.8	+2.4	16.0	+2.9	10.2	+1.2	16.6	+1.5	12.0	+1.9
2,500	13.7	+2.5	10.6	+2.3	12.2	+2.1	7.4	+1.3	14.2	+1.6	8.5	+1.2
3,000	10.5	+2.2	7.3	+2.1	8.0	+0.8	4.5	+1.3	11.8	+1.6	5.5	+0.7
3,500	7.8	+2.6	3.8	+1.6	6.6	+2.1	1.3	+0.9	9.7	+2.0	2.4	+0.4
4,000	4.7	+2.6	0.8	+1.4			−1.9	+0.4	6.6	+1.7	0.0	+0.4
4,500	2.0	+2.7	−0.7	+2.7			−4.7	+0.3	3.5	+1.4		
5,000			−3.7	+2.3			−7.4	+0.2	1.7	+1.8		

RELATIVE HUMIDITY (%)

Surface	63	−4	72	+6	55	−9	75	+8	79	+3	70	+4
250	63	−4			55	−9			81	+5	70	+4
500	61	−4	69	+5	55	−12	75	+9	85	+9	69	+3
750	60	−3	65	+4	55	−14	71	+8	83	+8	69	+3
1,000	59	−3	61	+2	56	−13	67	+6	71	0	69	+3
1,250	59	−2	58	+1	57	−11	65	+7	61	−7	66	+1
1,500	60	+1	58	+2	58	−11	62	+6	56	−9	61	−3
2,000	57	+2	55	+1	59	−6	59	+6	50	−10	59	−1
2,500	54	+3	52	−3	62	−3	58	+6	47	−7	59	+3
3,000	48	−1	50	−4	64	+2	57	+5	43	−7	59	+6
3,500	46	−5	47	−5	39	−19	53	+3	26	−20	52	+3
4,000	44	−5	45	−6			52	+4	26	−17	43	−3
4,500	51	+2	42	−10			44	0	24	−18		
5,000			38	−11			39	−2				

VAPOR PRESSURE (MB.)

Surface	20.93	+1.59	17.52	+3.13	19.17	+0.41	13.38	+1.99	25.79	+2.56	18.19	+1.62
250	20.87	+1.65			18.64	+0.17			25.14	+2.71	17.96	+1.60
500	19.90	+2.59	16.66	+2.92	16.47	−0.31	13.09	+1.90	23.43	+2.94	16.02	+1.49
750	18.39	+2.81	15.07	+2.75	15.11	−0.36	11.92	+1.70	21.18	+2.55	15.01	+1.78
1,000	16.78	+2.56	13.81	+2.63	14.38	+0.05	10.87	+1.60	17.45	+0.96	13.76	+1.70
1,250	15.19	+2.34	12.38	+2.26	13.43	+0.36	9.70	+1.43	14.04	−0.66	12.37	+1.51
1,500	13.95	+2.58	11.17	+2.07	12.41	+0.33	8.73	+1.27	11.96	−1.01	10.88	+1.20
2,000	10.76	+2.10	8.79	+1.41	10.49	+0.71	7.19	+1.13	9.00	−1.15	8.32	+0.81
2,500	8.25	+1.79	6.85	+0.76	8.77	+0.64	5.95	+0.93	7.10	−0.75	6.49	+0.85
3,000	5.78	+0.89	5.37	+0.41	7.17	+0.43	4.93	+0.69	5.42	−0.75	4.94	+0.80
3,500	4.53	+0.49	3.91	−0.05	4.31	−1.41	3.69	+0.22	2.70	−2.17	2.87	+0.08
4,000	3.33	+0.32	2.81	−0.46			2.90	+0.05	1.89	−2.00	1.37	−0.47
4,500	2.62	+0.22	1.98	−0.74			1.80	−0.44	1.19	−2.13		
5,000			1.07	−1.13			1.20	−0.51				

TABLE 2.—*Free-air resultant winds (m.p.s.) during September, 1925*

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters)				Drexel, Nebr. (396 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)			
	Mean		8-year mean		Mean		10-year mean		Mean		5-year mean		Mean		8-year mean		Mean		7-year mean		Mean		8-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 23° W.	3.6	S. 1° W.	3.1	S. 5° W.	2.1	S. 10° W.	1.7	N. 37° E.	2.8	N. 59° E.	2.7	N. 77° E.	0.6	W.	0.6	S. 23° W.	3.6	S. 20° E.	1.8	S. 8° W.	1.4	S. 45° W	1.3
250	S. 24° W.	3.9	S. 2° W.	3.3					N. 35° E.	2.8	N. 56° E.	2.5					S. 22° W.	3.8	S. 19° E.	2.4	S. 14° W.	1.6	S. 45° W.	1.6
500	S. 36° W.	5.8	S. 10° W.	4.5	S.	2.8	S. 7° W.	2.5	N. 27° E.	2.8	N. 52° E.	2.8	S. 60° E.	0.6	S. 75° W.	0.8	S. 22° W.	4.9	S. 11° E.	3.8	S. 35° W.	3.7	S. 45° W.	3.3
750	S. 39° W.	7.0	S. 17° W.	5.1	S. 18° W.	4.0	S. 22° W.	3.7	N. 39° E.	2.9	N. 60° E.	3.2	S. 35° E.	0.7	S. 60° W.	1.6	S. 19° W.	5.5	S. 5° E.	4.1	S. 48° W.	4.8	S. 56° W.	4.3
1,000	S. 41° W.	6.8	S. 26° W.	4.9	S. 25° W.	5.4	S. 31° W.	4.1	N. 60° E.	2.6	N. 66° E.	3.2	S. 6° E.	1.1	S. 60° W.	2.2	S. 19° W.	5.9	S. 4° W.	4.3	S. 62° W.	5.3	S. 63° W.	4.9
1,250	S. 43° W.	6.3	S. 33° W.	4.8	S. 28° W.	5.3	S. 46° W.	4.3	N. 48° E.	1.7	N. 53° E.	3.0	S. 28° W.	2.0	S. 64° W.	2.8	S. 27° W.	7.5	S. 2° E.	4.4	S. 69° W.	6.0	S. 68° W.	6.0
1,500	S. 43° W.	6.7	S. 42° W.	4.9	S. 30° W.	5.8	S. 55° W.	4.9	N. 53° E.	0.6	N. 56° E.	2.2	S. 46° W.	3.2	S. 72° W.	3.6	S. 24° W.	7.9	S. 1° E.	4.2	S. 77° W.	7.0	S. 72° W.	6.5
2,000	S. 41° W.	7.3	S. 49° W.	5.7	S. 40° W.	5.5	S. 67° W.	5.7	S. 45° E.	1.5	N. 60° E.	1.6	S. 65° W.	4.8	S. 77° W.	5.0	S. 18° W.	8.2	S.	3.9	S. 80° W.	9.3	S. 75° W.	8.3
2,500	S. 40° W.	7.8	S. 57° W.	5.4	S. 42° W.	7.0	S. 74° W.	7.3	S. 22° E.	7.0	N. 65° E.	1.2	S. 70° W.	6.7	S. 83° W.	6.7	S. 12° W.	7.3	S. 3° E.	3.7	S. 82° W.	11.2	S. 75° W.	9.9
3,000	S. 37° W.	8.8	S. 51° W.	6.3	S. 49° W.	8.3	S. 80° W.	9.1	S. 22° E.	8.0	S. 5° E.	0.2	S. 74° W.	9.0	S. 87° W.	8.7	S. 13° W.	7.2	S. 2° E.	3.7	S. 89° W.	13.8	S. 73° W.	12.6
3,500	S. 42° W.	9.3	S. 57° W.	6.4	S. 63° W.	5.9	W.	10.2	N. 45° W.				S. 72° W.	9.5	S. 88° W.	9.8	S. 20° W.	6.7	S. 3° W.	3.0	N. 86° W.	10.9	S. 80° W.	11.9
4,000	S. 34° W.	9.4	S. 60° W.	7.7	S. 78° W.	5.8	N. 78° W.	11.5	N. 45° W.				S. 89° W.	11.9	N. 77° W.	11.7	S. 16° W.	10.5	S. 1° W.	3.4	S. 82° W.	10.7	W.	10.2
4,500	S. 78° W.	7.9	N. 89° W.	9.8	N. 87° W.	3.8	N. 72° W.	11.9					N. 76° W.	12.9	N. 74° W.	12.8	S. 13° W.	12.3	S. 2° W.	5.2	S. 22° W	15.0	N. 83° W.	9.9
5,000	S. 67° W.	7.0	S. 89° W.	11.4	N. 31° W.	4.0	N. 62° W.	13.7					N. 78° W.	15.2	N. 79° W.	14.4	S. 68° E.		S. 24° E.	4.4				

TABLE 3.—*Mean free-air temperature, humidity, vapor pressure and resultant wind (m. p. s.) during September, 1925, at Washington, D. C.*

Altitude m. s. l. (meters)	Naval air station (7 meters)			Weather Bureau (34 meters)	
				Wind	
	Temperature, °C.	Relative humidity per cent	Vapor pressure, md.	Direction	Velocity
Surface	20.4	81	19.94	N. 16° W.	1.0
250	19.5	76	17.67	N. 42° W.	1.3
500	19.0	71	16.12	N. 60° W.	1.8
750	18.1	69	14.79	N. 49° W.	1.8
1,000	17.1	70	14.08	N. 55° W.	3.8
1,250	16.2	69	12.94		
1,500	15.4	68	12.00	N. 65° W.	6.2
2,000	13.4	60	9.31	N. 64° W.	7.4
2,500	10.9	55	7.23	N. 66° W.	7.8
3,000	7.6	51	6.16	N. 67° W.	8.3
3,500	3.8	45	5.60	N. 70° W.	8.7

THE WEATHER ELEMENTS

By P. C. DAY, In Charge of Division

PRESSURE AND WINDS

The day-to-day fluctuations of atmospheric pressure were on the whole moderate, but the distribution of cyclonic and anticyclonic areas at times greatly influenced the temperature and precipitation conditions over large areas, most notably during the first decade, when unusually stagnant atmospheric conditions existed over most central and southeastern districts. An anticyclone of only moderate dimensions became established over the Southeastern States, while moderately low pressure was maintained over the more northern districts from the Rocky Mountains eastward, due to the passage over that region of several unimportant low-pressure areas.

Due to the slight pressure gradients over the eastern half of the country there was little air movement, and under the influence of clear skies and a generally dry condition of the soil due to previous long periods without material precipitation, particularly over the Gulf States and portions of the Ohio and Mississippi Valleys, the atmosphere became unduly heated and one of the longest periods of intense heat ever experienced in September resulted. The maximum effects were felt from about the 4th to the end of the first decade, the highest temperatures over large portions of the area referred to ranging from 100° to 110° or even higher daily, records in many cases never before reached in September, and in some cases not previously exceeded in any summer month. At the same time the drought conditions that had previously existed over much of the same region grew daily more severe due to the extreme heat, the combination of heat and lack of rain resulting in one of the longest and severest droughts ever known, the more important details of which are given later in this section.

By the end of the first decade the pressure distribution had become reversed; cyclonic conditions developed in the Southwest and gradually overspread the districts to the eastward, while an anticyclone entered the Northwest bringing cooler weather as it moved to the eastward.

Shortly after the middle of the month moderately high pressure again became established over the Southeastern States and unseasonably hot weather again prevailed over the South and Southeast, though the daily maxima did not reach the high points registered earlier in the month.

Near the end of the second decade the atmospheric circulation became more active; a cyclone of considerable proportions, developing over the Northwest, moved rapidly eastward, quickly followed by the first important anticyclone of the month, which overspread the upper Missouri Valley by the morning of the 20th, attended by sharp falls in temperature over northern districts. As it moved rapidly eastward the cooling effects extended into the central and southern districts to some extent, though not sufficiently to lower the temperature to normal.

The last decade of the month, save as indicated above, was without important pressure variations, though low pressures persisted over the central valleys and considerable precipitation occurred between the Great Plains and Appalachian Mountains, though little fell over the dry areas of the Southeast.

The average pressure was mainly below normal, slight excesses occurring along the immediate Gulf coast, from Lake Superior to Montana and northward into Canada, and along the coast of California. The greatest deficiencies occurred over the central valleys. Compared with the preceding month the pressure averaged considerably lower in nearly all portions, the exception being a small area over the extreme Northeast, locally in northern California, and in portions of the upper Missouri Valley and adjacent Canadian areas.

In the absence of persistent important high or low pressure areas, as shown by the chart of average pressure, there was much local diversity in the directions of the prevailing winds, though they were mainly from the south in the east Gulf and South Atlantic States and over the Great Plains, and from northerly points along the Pacific coast.

Despite the general absence of extensive cyclonic areas there were apparently more than the usual number of wind or other damaging storms distributed through all portions of the month and in nearly all sections east of the Rocky Mountains, and a few to the westward. No important loss of life occurred, however, save that occasioned by the wreck of the airship *Shenandoah* in Ohio on the 3d. The more important facts in connection with the severe storms of the month appear in the table immediately following this section.

TEMPERATURE

September, 1925, set a mark for heat over the territory from the lower Mississippi Valley eastward, and from the Ohio drainage area southward to the Gulf, that in many instances has probably not been surpassed in the authentic history of that part of the country, and that will probably stand unsurpassed for as long in the future.

The center of this heated area embraced the interior of the Gulf and South Atlantic States, the southern Ohio drainage, and portions of the middle Mississippi Valley. In the central portion of this area the average daily temperatures were normal or above on every day of the month, and at many points in the outlying portions only one or two days had temperatures below. Here, too, the averages and the maxima for the month were the highest ever known in September and in a number of cases the highest for any month. Despite the intense and long-continued heat few cases of prostration occurred, and the ordinary occupations were pursued without material hindrance, due probably to the dry condition of the atmosphere.

Aside from the intense heat over the regions referred to above, temperature conditions over the country were not

far from normal, though the month was moderately cool over most districts from the Rocky Mountains westward, particularly in the interior valleys of California, where August had likewise been mainly cool. Considerable delay resulted in the ripening and drying of fruit in California due to continued cool weather, but otherwise the month was favorable in most Western States.

The warmest periods were from the 1st to 3d over the districts west of the Rocky Mountains and over the northern Plains, and from the 4th to 10th in most central and eastern districts, extending a few days later over the Northeastern States.

The lowest temperatures occurred on the first two days in portions of the east Gulf and South Atlantic States, but in most other States the coldest weather was during the last decade.

Temperatures were below freezing in all the northern tier of States and generally at the higher elevations of the western Mountain sections. As a rule, however, the main crops had advanced too far toward maturity to suffer material damage from frost.

PRECIPITATION

September added another to the long list of months in 1925 with generally deficient precipitation, and unfortunately this condition included the greater part of the territory from central Texas eastward and northeastward to the Atlantic coast where drought has already persisted since early in the year. Outside of this area the drought conditions were mostly relieved at some time during the month.

In portions of the upper Mississippi Valley and thence eastward some relief occurred during the first week, and there were some heavy rains in southern Texas, and moderate falls occurred in the far Northwest.

A heavy fall in the drainage area of Squill Chuck Creek, Chelan County, Wash., on the 5th caused the loss of 14 lives and much damage to property, and a severe hailstorm on the same date in Douglas County, same State, caused great damage to fruit.

During the second week good to heavy rains occurred from New Mexico and northern Texas northeastward to the Great Lakes, effectually relieving the shortage previously existing in portions of the Ohio and Mississippi Valleys and West Gulf States. The third week had continued good rains in portions of Kansas and Missouri, and more or less rain fell in nearly all other districts save from central Texas and Oklahoma eastward, where there was little or none, only light showers if any occurring during the week in the southern Appalachian region where drought was daily growing more serious.

The last decade of the month had considerable rain along the immediate Gulf coast, over much of Texas and thence northeastward to the Great Lakes, but it was scanty in the more eastern districts, except locally. Some relief occurred in the worst drought area, but in many sections of western North Carolina and the near-by areas of southwestern Virginia, eastern Tennessee, the northern portions of Alabama, and Georgia, and western South Carolina the drought was still unbroken at the close of the month.

A somewhat detailed account of the drought conditions existing over much of the country from the Rocky Mountains eastward during the spring, summer, and early fall months of the present year follows at the end of this section.

SNOWFALL

Some notably heavy snows occurred in the mountain districts of Montana, particularly near Helena, on the 19th and again on the 27th and 28th. Heavy damage to trees, shrubs, and overhead wires occurred, due to the wet condition of the snow and the fact that the foilage had not yet fallen.

Snowfalls up to 5 inches, or slightly more, occurred in the main chain of the Rocky Mountains from northern New Mexico to Montana, and similar amounts were reported from the high mountains of California, Oregon, and Nevada. East of the Rocky Mountains not more than traces were reported and these mainly in the Dakotas.

RELATIVE HUMIDITY

As is usually expected, the excesses and deficiencies of relative humidity are largely confined to similar areas of precipitation, and the present month is no exception, as the relative humidity was greatly deficient from Arkansas and eastern Texas northeastward to southern New England, closely coinciding with the area of deficient precipitation. Over most other parts of the country there was generally a small excess, except in portions of the western mountain regions where it was large.

THE DROUGHT OF 1925, OVER THE SOUTHEASTERN UNITED STATES

The year 1925 has been marked by one of the most widespread droughts of recent decades, and the intensity in the southern Appalachian region equaled or exceeded anything in the memory of the oldest inhabitants. Here August and September usually brought the climax, though in portions of the affected area substantial relief was received by mid-September.

In the Middle and West Gulf States, dryness which set in during the midsummer of 1924 was practically unrelieved till far into 1925, occasionally not until the fall. Many districts just west of the Mississippi River, as far north as Iowa, and in the middle or southern Plains likewise began to suffer from dryness in the fall of 1924, and the rains in subsequent months were too scanty to give complete relief till about the close of the present growing season.

The area which was decidedly affected by the scanty precipitation of 1925 includes much of New Mexico, large parts of Texas, Oklahoma, and Kansas, and practically all districts to eastward of these. The northern limit usually is found near the fortieth parallel, being near the Kansas River in eastern Kansas, and the Missouri River in Missouri. The southern parts of Illinois, Indiana, and Ohio were considerably affected, also large portions of the Virginias with a little of Maryland. In Florida, however, the peninsula has had either more rainfall than usual or about as much in most months of the last 12.

In much of southern and eastern Texas the early portion of the winter was marked by abundant rains, and most of the other Gulf States had excessive falls and often very damaging floods during December and January. However, from northwestern Texas northeastward over Oklahoma and northwestern Arkansas and most of the Ohio Valley dry conditions set in either before or during January and the same is true of eastern Tennessee and western North Carolina, where light rains, far apart, became the prevailing condition.

In early February the dry weather became dominant in nearly all parts of the Gulf States and in much of the South Atlantic and southern Middle Atlantic States, and early in March from northern Alabama northward over Tennessee, also over southeastern Arkansas. Usually the States of Oklahoma, Kansas, Missouri (save the southern part), and Iowa had ample moisture till May or later, and the immediate South Atlantic coast, as a rule, was well watered till at least the end of April.

Important portions of the dry area had liberal rains during certain limited periods of time, thus separating the drought into two or more portions. For example, the latter half of April with early May brought temporary relief in most of northern Texas; June gave helpful rains to much of Kansas and Missouri; also to much of southern Georgia, and the districts north of the lower Ohio River; while July and the first fortnight of August had helpful rains in Oklahoma, Arkansas, western Tennessee and northern Mississippi. These rains which came between comparatively dry periods were of prodigious importance in partially saving the important crops, and often were sufficient, in combination with thorough cultivation, to give yields above average for cotton or other staple crops in large portions of the States affected.

Considerable portions of New Mexico and Texas have received as much rain as normal each month since June, but most of southern Texas, also the north-central and northeastern portions, like nearly all States to northeastward and eastward of Texas, reached the climax of the drought late in the summer.

The last 10 days of August and the opening week of September had remarkably hot and dry weather in the eastern portions of Kansas, Oklahoma, and Texas and practically everywhere eastward to the Atlantic Coast. The corn and cotton crops were much affected by this weather, being greatly reduced in prospects and too rapidly pushed to early maturity.

The end of the drought came by the 10th of September over nearly all parts of Kansas, Missouri, Oklahoma, Arkansas, Louisiana, and northern Texas, and by the middle of September over the lower half of the Ohio Valley and some parts of Tennessee. It was late in September or early in October before some parts of the last-named State and most portions of the Virginias received ample rains, while most portions of the Carolinas and Georgia, and some parts of the East Gulf States were relieved after the middle of October, and a few districts, chiefly in South Carolina, are still but partially relieved.

The dry weather did hardly any damage to field crops anywhere north of the Ohio River, save in southern Illinois and Indiana, but pastures and meadows were considerably affected in portions of Ohio. In most of southern Missouri and some parts of Kansas, and especially in Arkansas, Tennessee, and North Carolina, and to southward the corn crop suffered greatly. From central Texas southward, in most of Arkansas, Georgia, and the Carolinas, save eastern North Carolina, and in some parts of Alabama the cotton crop was seriously reduced in yield, but the rainfall shortage was not great enough in many important portions to cut the yield to the average, and high quality of crop was reported for an unusually extensive area. Potatoes, tobacco, and oats were seriously hurt in many States and portions of States, while nearly everywhere south of the Ohio River pastures and forage crops were so greatly harmed as to cause vast loss or inconvenience. In several localities sale of cattle for removal or slaughter was found necessary in view of scanty prospective supply of feed for winter. The condition of pastures in the southern Appalachian region, has seldom, if ever, been worse, and here fruit and forest trees in many tracts have been defoliated, and it is feared they will prove to be dead when next spring comes.

The shortage of water was annoying in several districts west of the Mississippi River and was the cause of enormous trouble and expense in large areas east of the Mississippi and south of the Ohio and in the coal-mining region of southern Illinois. Almost everywhere from the lower and middle Ohio River and the middle latitudes of West Virginia and Virginia southward nearly to the southern limits of Mississippi, Alabama, and Georgia, and nearly to the South Atlantic coast, the farm and city supplies were failing or on the verge of failing for several weeks, or in a few districts for months. In the southern Appalachian region the water-power situation was the worst in memory, small streams never before known to fail being dry or reduced to occasional pools, while large streams reached lower stages than any indicated by available records.

When comparison is made with previous droughts it is found that hardly any area west of the Mississippi River has suffered as much as in some one or more previous years. Most of Texas, save the easternmost and north-central counties, had a more serious drought in 1917 than during the present year. From the eastern coast of Texas northeastward to central Mississippi the late months of 1924 were drier than any part of this year, while in the central valleys 1901 set a mark far beyond the drought of the present year. Large portions of the Ohio Valley and the Virginias report that the dryness of 1881 remains the worst in memory, but usually from southwestern Virginia southward and southwestward to the north-central portions of Georgia and Alabama and as far east as the middle counties of the Carolinas the drought of 1925 appears to be the most severe that the region has ever known.

SEVERE LOCAL HAIL AND WIND STORMS, SEPTEMBER, 1925

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Oxford (10 miles north of) southeastward into Vance County, N. C.	1	5-6 p. m.	4 mi.	.....	$250,000	Heavy hail	Very heavy crop damage, especially to tobacco	Official, U. S. Weather Bureau.
Ohio	3	.....	.....	14	.....	Thunderstorms	Storms general over State; with the exception of the wrecking of the airship, Shenandoah, only slight damage resulted.	Cleveland Times (Ohio).
Providence, R. I., and vicinity.	4	8:01 a. m.–12:18 p. m.	.....	.....	.....	do	Some damage by lightning	Official, U. S. Weather Bureau.
Quincy Wash. (6 miles north of).	5	A. m.	.....	.....	.....	Hail	No material damage	Do.
Southwestern Douglas County, Wash.	5	P. m.	.....	.....	200,000	Destructive hail	Apple crop made practically unsalable	Do.
Browntown, Ill	6	2 p. m.	367	3	25,000	Wind squall	A church and garage wrecked; 12 persons injured	Do.

[1] Yards when not otherwise specified; mi. signifies miles.

Severe local hail and wind storms, September, 1925—Continued

Place	Date	Time	Width of path[1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Washington, D. C. (southeast part of).	6	8 p. m.				Wind and rain	Two persons injured; 2 houses unroofed and a wall blown down.	Evening Star (Washington, D. C.).
Eldorado, Kans., and vicinity.	6	P. m.				Series of wind and rain storms.	Farm homes and barns damaged, and oil rigs wrecked. Other minor damage.	Wichita Eagle (Kans.).
North Kansas City, Mo.	6	do	234		$300-400	Small tornado	One house moved on foundation; small outhouses, poles carrying high tension wires, trees, and telephone poles blown down.	Official, U. S. Weather Bureau.
Paulding County, Ohio	6	do				Wind	Buildings and corn blown down	Do.
Northeast Shelby County and northwest Marion County, Mo.	7	5 p. m.	3,520		20,000	Thunderstorm and hail.	Roofs and windows damaged; crops ruined over path 30 miles long.	Do.
Hopkins (near), S. C.	7	5 p. m.		1		Thunderstorm	A negro and a mule killed by lightning	Do.
Ardmore, Okla. (southeast of).	7	5-6 p. m.	100		1,100	Wind	Some property damage; slight crop injury; 1 person injured.	Do.
Elmore, Tallapoosa and Montgomery Counties, Ala.	7	P. m.				Wind and rain	Cotton crop considerably damaged	Montgomery Times (Ala.).
Steffenville, Mo. (south of)	7		3,520		15,000	Severe hail	Chickens killed; corn torn up; garden truck injured. Path 10 miles long.	Official, U. S. Weather Bureau.
Mexico, Mo.	8	3 p. m.	440		10,000	Wind and electrical.	Small sheds and a garage demolished; telegraph wires broken halting traffic for a while; 1 building struck by lightning; path 5 miles long.	Do.
Lexington, Mo.	8	3:30 p. m.	350		35,000	Thundersquall	Trees and poles broken; electric power suspended; considerable damage to city property.	Do.
Wayne County, Ill.	8	4 p. m.				Wind	Considerable property damage of minor importance; trees blown down.	Do.
Sparta, Ill. (4 miles west and northwest of).	8	5 p. m.	1,760		13,000	Wind and hail	Damage to property and crops, principally by wind, over path 3 miles long.	Do.
Southwestern Indiana	8	5 p. m.		1		Wind and electrical.	Much damage to farm buildings; 1 person fatally injured.	Evansville Courier (Ind.).
Terre Haute, Ind. (west of)	8	6-8 p. m.	30-100	1	500	Wind squall	Branches, signs, and awnings blown down; telephone and telegraph service interrupted; interurban traffic delayed; 1 person injured.	Official, U. S. Weather Bureau.
Monmouth, Ill. (vicinity of)	8					Electrical and wind.	10 head of cattle and 3 horses killed; some corn blown down.	Do.
Keokuk, Iowa	8					Hail	Slight damage in place	Do.
Armstrong, Ill.	9	A. m.			75,000	Electrical	Fire caused by lightning destroyed several business properties.	Do.
Peoria, Ill.	9	2:30-2:45 p. m.			20,000	Thundersquall	Damage to buildings in business section a few blocks wide; 7 or more persons injured by flying glass.	Do.
Walworth, Kenosha, and Racine Counties, Wis.	9	3-4 p. m.	2-5 mi.	1	150,000	Severe wind and hail.	Extensive property and crop damage; latter estimated at $100,000. Path 30 miles.	Do.
Lafayette to Bennettstown, Ky.	9		3 mi.			Hail and wind	Tobacco badly damaged over path several miles long.	Do.
Inman, S. C.	9	P. m.		1		Thunderstorm	No property damage reported	Do.
Kokomo, Ind.	9					Heavy hail	Crops, windows, etc., considerably damaged	Do.
Montgomery, Ala.	9	P. m.			4,000	Electrical	Four houses burned	Do.
Southern and central counties, Mich.	9					Thunderstorm, hail and wind.	Trees uprooted, water tank and chimneys blown down, and several large barns wrecked at Pontiac; 2 buildings struck by lightning, barns, silos, telegraph and telephone poles prostrated in and near Fenton; other property damage.	Do.
Peoria, Ill.	9	11:50 p. m.			125,000	Electrical	Building fired by lightning, destroying many agricultural implements.	Do.
Cullman and Madison Counties, Ala.	9-10					Wind and hail	Cotton damaged	Do.
Anniston, Ala.	10	2:30 p. m.			8,000	Severe thunderstorm and hail.	Plate-glass windows broken; trees and a small dwelling blown down; 2 persons injured.	Anniston Star (Ala.).
Bethel, Kans.	10	4 p. m.	160		5,000	Tornado	Large poultry house and garage demolished	Official, U. S. Weather Bureau.
Plainview, Tex., and vicinity.	10	4-5 p. m.	2,640		65,000	Hail	Crop damage severe in center of path 20 miles long.	Do.
Bicknell, Ind., and vicinity	10	P. m.			4,000	Thunderstorm	Electrical systems damaged; several mules killed; barns leveled; houses struck by lightning; highways obstructed.	Star (Terre Haute, Ind.).
Floyd, N. Mex.	10					Small tornado	6 head of cattle killed by lightning; school damaged.	Official, U. S. Weather Bureau.
Gorin, Mo., and northwest of.	10	P. m.			4,000	Thundersquall	Small buildings damaged; fruit trees stripped; corn injured; valuable cow killed at Downing.	Do.
Keokuk, Iowa	10					Wind and hail	Damage in places	Do.
Monmouth, Ill.	10					Electrical and wind.	2 barns burned and some corn prostrated	Do.
Northern New York	10					Thunderstorms	Several barns destroyed	Do.
Pines, N. Mex.	10					Severe hail	Storm over sparsely settled country; no damage	Do.
Wheaton, Ill.	11	1 a. m.	266		50,000	Tornado	Some farm buildings wrecked; 25 dwellings and 3 greenhouses damaged; 1 person injured. Path 7 miles long.	Do.
Waukegan, Ill. (vicinity of)	11	2 a. m.			6,000	Severe electrical	Farm buildings and hay damaged by lightning	Do.
Akron, Mich. (vicinity of)	11	A. m.	880			Hail	Some property damage; bean crop severely beaten.	Grand Rapids Press (Mich.).
Chicago, Ill.	11	A. m.				Thunderstorm and wind.	Some buildings damaged; trees blown down; parts of city in darkness for several hours.	Chicago Journal (Ill.).
Grand Haven and Grand Rapids, Mich.	11	A. m.				Thunderstorms	Electric equipment of all kinds affected by storm; interurban car service interrupted; telegraph service impaired.	Official, U. S. Weather Bureau; Grand Rapids Press (Mich.).
Momence, Ill. (east and southeast of).	11	1 p. m.	440		45,000	Wind squall	Considerable crop and property damage	Official, U. S. Weather Bureau.
Centralia, Ill.	11	3:30-4:30 p. m.	200		20,000	do	Orchards and other property damaged considerably; 1 person injured.	Do.
Chelsea, Mich., and vicinity	11					Severe thunderstorm.	Barns and houses unroofed; telegraph and telephone poles and silos blown down; electric light service crippled.	Do.
Cleveland, Ohio	11	2:30 p. m.				Thunderstorm	Electric light service in some sections impaired; trees uprooted; signs torn down.	Cleveland Plain Dealer (Ohio).
Morganville and Wildwood, Ga.	11					High winds	Numerous trees prostrated	Official, U. S. Weather Bureau.
Northern Indiana	11	P. m.			23,000	High wind and a tornado.	Buildings, crops, and timber damaged. Tornado was near South Bend.	Do.
Logan County, Ill.	12	2:30 - 3:30 p. m.	3,520		85,000	Hail and wind	Crops damaged to the extent of $70,000; much glass broken; trees stripped; 1 barn and livestock destroyed by lightning; 3 persons injured.	Do.
Corpus Christi, Tex.	12					Thunderstorm	Several buildings and a schooner damaged by lightning; other minor property damage.	Do.

[1] Yards when not otherwise specified; mi. signifies miles.

Severe local hail and wind storms, September, 1925—Continued

Place	Date	Time	Width of path [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Fort Hancock, McNary, and Acala sections of Texas.	12	P. m.			$200,000	Hail and rain	Cotton crop badly damaged	El Paso Times (Tex.).
Harrisburg, Pa., and vicinity	12–13				250,000	Thunderstorm and wind.	Corn flattened and other minor damage	Official, U. S. Weather Bureau.
New York State	12–13			1	400,000	Electrical wind and rain.	Much damage throughout State, especially in Tonawanda Valley, northwest Wyoming County, where winds were of tornado intensity. Heavy loss of fruit and silage corn, damage to buildings, overhead wires, etc. Several persons injured.	Do.
Scranton, Pa	13	5:33 – 8:55 p. m.			60,000	Severe thunderstorm.	General damage throughout city reported	Do.
Terre Haute, Ind	13	3:20 – 4:45 p. m.			100,000 6,000	Thunderstorm	Public utilities service interrupted; 1 fire by lightning	Do.
Centre Ossipee, N. H	13		1,760			High wind	A number of homes partially or wholly wrecked	Binghamton Morning Sun (N. Y.).
Davidson, Okla., and vicinity.	13	5:40 p. m.	3,520		502,000	Destructive hail	Crops, principally cotton, severely damaged over path 12 miles long.	Official, U. S. Weather Bureau.
Freeland, Pa	13	5:30 – 5:40 p. m.				Thunderstorm, wind, and rain.	Trees uprooted, chimney blown down, and other minor damage.	Do.
Kenton, Okla. (near)	13					Moderate hail	Slight damage reported	Do.
Northeast Washington, northern Frederick, and Carroll Counties, Md.	13					Thunderstorm and wind.	Some corn blown down and trees uprooted	Do.
Rush, Colo., and vicinity	13		3 miles		45,000	Destructive hail and thunderstorm.	Heavy crop damage, beans badly beaten, and foliage destroyed over path 38 miles in length.	Do.
Cove, Oreg., and vicinity	15	1:30 p. m.	3,520		8,000	Heavy hail	Prune and apple crops injured; roofs and windows damaged.	Do.
Columbia, S. C	15	3:25 – 4:30 p. m.			10,000 100	Thunderstorm	Garage struck by lightning; no other damage reported.	Do.
Cheraw, S. C. (near)	15	P. m.	880		10,000	Heavy hail	Unpicked cotton damaged	Do.
Eaton County, Mich	15					Squall	Some small buildings, telegraph and telephone poles blown down, blocking main highways.	Do.
Arizona	15–19					Wind and rain	Main highway washed out, others impassable; some damage to railway beds.	Do.
Wingville and Pocahontas districts (7 miles north of Baker), Oreg.	16	12:45 p. m.			35,000	Heavy hail	Considerable loss to fruit, grains, and other crops.	Do.
Columbia, S. C. (13 miles east of).	16	4 p. m.			500	Thunderstorm	School building struck; 4 persons injured	Do.
Lake Swamp and Ebenezer, S. C.	16	P. m.			10,000	Severe hail	Character of damage not reported	Do.
Cerro Gordo and Worth Counties, Iowa.	16				5,000	Hail	Hail fell where little damage could be done	Do.
Hammonton, N. J	16					Wind	Inn damaged; trees uprooted; all windows in a bus blown out.	New York Herald-Tribune (N. Y.).
Taylor and Clay Counties, Iowa.	17	P. m.				Electrical and wind.	Telephone, and telegraph poles and wires damaged; buildings damaged in Clay County.	Official, U. S. Weather Bureau.
Tucson, Ariz. (near)	18	5:30 p. m.			2,000	High wind	Veterans' Hospital damaged	Do.
Shannon, Ill	18				500	Wind	Small building unroofed	Do.
Yankton, S. Dak	19	5 p. m.				Thunderstorm	Several barns and other buildings in suburbs blown down; rural telephone poles and wires prostrated.	Do.
Sioux City, Iowa	19	6:56–6:58 p. m.	440		750	Wind and hail	Two buildings unroofed; 240 windows broken	Do.
Houghton, Mich	19					Thunderstorm	Considerable damage to electric circuits; basements flooded; street car tracks covered with sand; pavement in one street destroyed.	Do.
Minneapolis, Minn	19					Wind	A number of persons were injured. Character of damage nor reported.	Do.
Burlington, Vt	20					do	Branches torn off, some trees uprooted causing damage to wires and other property.	Burlington Free Press (Vt.).
Houghton, Mich	20					do	Some damage to electric wires; many trees and windows broken.	Official, U. S. Weather Bureau.
Western New York	20					Wind and electrical.	Trees down, chimneys shattered, billboards wrecked. Some damage by fires; Sayre and other valley towns suffer most.	Buffalo Courier (N. Y.).
Due west, South Carolina	23		880		1,000	Severe thunderstorm.	Buildings and poles damaged; some damage to Weather Bureau equipment.	Official, U. S. Weather Bureau.
Pecos County, Tex. (north part of).	23		1,760		80,000	Heavy hail	Heavy crop damage. Buena Vista hard hit	Do.
Fort Benning, Ga	24					Wind	Some tents of the Motor Transportation Corps unroofed.	Do.
Evansville, Ind	26	5:30–5:45 p. m.			6,700	Thunderstorm and wind.	Trees, signs, and overhead wires damaged; Wild West show tents blown down. Four persons injured.	Do.
Milan, Tenn., and vicinity	27					Thunderstorm	Three barns demolished; several roofs torn off	Do.
Miami, N. Mex	30	4 p. m.	3,520		500	Severe hail	No property damage reported	Do.
Abbott, N. Mex	30	6–11 p. m.	3 mi.			do	No crops in path of storm; minor damage	Do.

[1] Yards when not otherwise specified; mi. signifies miles.

STORMS AND WEATHER WARNINGS

WASHINGTON FORECAST DISTRICT

Small-craft warnings were issued for portions of the north Atlantic coast on the 3d, 7th, 15th, and 20th.

On the evening of the 20th southwest storm warnings were ordered from Sandy Hook to Eastport and were followed by fresh winds along the coast and strong winds off the coast.

Frosts occurred in central and northern New England and northeastern New York on the 23d and again on the 26th. Warnings of the latter were issued the preceding morning, but those of the 23d were not expected, owing to indications of overcast skies.—*R. H. Weightman.*

CHICAGO FORECAST DISTRICT

The month, as a whole, was rather warm throughout the district, with the exception of Montana, where the temperature averaged below normal.

The distribution of rainfall was irregular, and the monthly total was in excess of the normal, except over the middle Rocky Mountain region and the central Great Plains. There was a considerable excess of precipitation over the middle Mississippi and lower Missouri Valleys.

Because of the advanced season, due to rather high temperature in the early summer and the closing days of August, together with the warm September, crops generally had reached maturity some one or two weeks earlier

than usual, and with few exceptions, were not susceptible to frost damage. No general frost warnings were issued and, as a rule, the local interests were protected by advance advices as far as practicable. This was especially the case in the cranberry marshes of Wisconsin, where abnormally low temperatures are the rule during frost conditions.

A disturbance of considerable intensity developed in the Northwest on the 18th, and moved in an easterly direction with its center over the northern Lakes, attended by strong shifting winds on the 20th. Storm warnings were ordered for western Lake Superior on the evening of the 19th and for the remainder of the Great Lakes on the morning of the 20th, apparently sufficiently in advance of the occurrence of the storm.

Rather strong winds also prevailed on the northern and central portions of the Great Lakes on the 30th, because of the development of a disturbance west of the Mississippi River and an area of high pressure of great magnitude which moved southeastward from the Canadian northwest over Ontario, these causing a steep barometric gradient over the Lakes.

There were no other storms of marked importance, so far as winds are concerned.

For the information of the pilots taking part in the First Annual Commercial Airplane Reliability Tour special forecasts were furnished to the aviators daily or twice daily from the time the planes left Detroit on September 28 until their arrival in Indianapolis October 2.

I was personally advised, moreover, by the flyers that the information was of great service to them; and a letter of appreciation was recently received from the aviation committee of the Chicago Association of Commerce.—*H. J. Cox.*

NEW ORLEANS FORECAST DISTRICT

A disturbance of moderate intensity appeared in the west Gulf off the mouth of the Rio Grande during the evening of the 6th, and northeast storm warnings were ordered displayed at 9 p. m. from Corpus Christi to Brownsville, and on the morning of the 7th were extended over the remainder of the Texas coast. The disturbance moved northward with diminishing intensity and storm winds occurred only on the western portion of the Texas coast. Small-craft warnings were displayed at Corpus Christi on the 17th, 24th, and 29th. No storm occurred without warning.—*I. M. Cline.*

DENVER FORECAST DISTRICT

Low pressures prevailed in the Rock Mountain region during the first two decades, attended by frequent showers and thunderstorms in the Denver district. An area of high pressure, accompanied by much lower temperatures, with occasional frost in the northern portion of the district, drifted slowly across the northern Rocky Mountain sections during the period from the 19th to the 24th. High pressures and low temperatures also prevailed in western Canada and the northern portion of the Rocky Mountain region from the 26th to the end of the month, while a LOW of moderate insensity advanced eastward from the plateau from the 24th to the 29th. This last disturbance was followed on the 30th by frosts in western Colorado, Utah, and northern Arizona, with freezing temperatures in southern Utah, the southwestern valleys of Colorado, and at the higher elevations of northern Arizona.

Warnings of frosts and freezing temperature were issued as follows: 21st, frost southwestern Colorado and at the higher elevations of northwestern Colorado, northern Arizona, and southern Utah; 22d, frost northern and western Colorado and at the higher elevations of northern Arizona and southern Utah; 23d, frost in northern and western Colorado and at the higher elevations of southern Utah; 24th, frost in southwestern Colorado; 29th, frost in northwestern Colorado, extreme northwestern New Mexico, and southern Utah, with freezing temperature in southwestern Colorado and at the higher elevations of southern Utah and frost or freezing temperature in north-central and northeastern New Mexico; 30th, frost in Colorado, northwestern and extreme north-central New Mexico, northeastern Arizona, and northern and eastern Utah, with freezing temperature in southwestern Colorado and at the higher elevations of northeastern Arizona and northern and eastern Utah. The warnings were generally verified.—*J. M. Sherier.*

SAN FRANCISCO FORECAST DISTRICT

The month opened with a well-defined area of high barometric pressure over the ocean, low barometric pressure over Alaska, and low barometric pressure over the continent west of the Rocky Mountains. This situation rapidly changed during the first two days of the month and on the second the HIGH over the ocean shifted northward and a disturbance formed some distance off the California coast. While the HIGH over the ocean moved northward and became centered over the Gulf of Alaska and the ocean to the southward, the pressure remained low along and off our coast. This area of low pressure persisted for several days and finally advanced eastward, crossed the coast line and the weather cleared throughout the Pacific States. In the meantime there were local showers in northern California and nearly all other sections west of the Rocky Mountains. The first rains of the season in northern California accompanied the changed pressure situation as described. The rains, coming early, did no material damage to fruit that was in the process of drying.

From the 8th to the 12th inclusive, the HIGH over the ocean was at all times well defined and of considerable extent, but centered far northwest of its normal position and with its major axis paralleling the meridians rather than the parallels of latitude, its former direction. This situation was attended by the formation of areas of low barometric pressure off our coast, one of which on the 16th assumed the characteristics of a disturbance of marked intensity off the Washington-Oregon coast, on which date at 8 a. m., one hundred and twentieth meridian time, a barometer reading of 29.20 inches was reported by the S. S. *Waitemata* while in approximately latitude 45 degrees north and 130 degrees longitude west. This disturbance instead of advancing eastward moved southward along the periphery of the HIGH to the westward and caused quite general rains in the north portion of northern California, the Pacific Northwestern States and the Plateau States during the succeeding several days. On the 16th storm warnings were ordered for coast stations at and north of Cape Mendocino, and while no storm winds occurred at coast stations, winds of gale force prevailed off the coast as shown by reports received by radio from ships. The rains in California were forecast sufficiently ahead of their occurrence to permit of protective measures being taken to prevent damage to drying fruit. The weather became again fair throughout the forecast district on the 20th, and remained so until the 25th, when conditions became unsettled along the north coast. In the meantime warnings of high fire hazard in the forested areas were issued on the 21st for southern California, where during the following several days the relative humidity was decidedly below normal.

On the morning of the 22d similar warnings were issued to forestry interests in the States of Washington and Oregon. These forecasts were minutely verified by the subsequently recorded temperature, humidity, and winds. After the 25th and until the end of the month the weather remained unsettled and showery in the northern half and fair in the southern half of the district, and at its close the temperature was low with frosts in the Plateau States.

Special weather forecasts for the information of driers of fruit were issued daily during the month and broadcast by radiophone. A specimen of this type of forecast, i. e., the one issued on the 30th, follows:

In the Santa Rosa, Napa, Sonoma, Santa Clara, Sacramento and San Joaquin Valleys the weather will remain fair during the next several days with moderate temperature and gentle changeable winds. Good drying weather is indicated.

—*E. H. Bowie.*

RIVERS AND FLOODS

By H. C. FRANKENFIELD

The rise in the lower Rio Grande in early August, on which report was deferred until this issue of the REVIEW, passed flood stage at only one Weather Bureau gaging station—San Benito, Tex. No reports of damage have been received.

Virtually coincident with the above, however, another rise of more importance was in progress in the vicinity of and below El Paso, Tex. Definite reports are similarly lacking for this flood, though revised estimates by newspapers place losses resulting from it at $275,000—chiefly in crops and levee damage. The progress of the crest, which gradually diminished, was evident in moderate rises downstream later in August, but flood stage was not reached at any Weather Bureau station.

A third and much more serious rise occurred in the vicinity of El Paso early in September. Of this flood Mr. Robert M. Shaver, official in charge of the Weather Bureau office at El Paso, reports as follows:

The occurrence of heavy rains over the upper portion of the Rio Grande watershed between El Paso and the Elephant Butte Dam, which is 122 miles northwest of El Paso, on August 31 and September 1, 1925, caused a rapid rise in the river.

Limited overflows occurred at a few points in the valley northwest of El Paso on September 1 and 2; and serious overflows at several places from 6 miles northwest to 40 miles southeast of El Paso during September 2, 3, 4, and 5.

Engineers estimated that 11,500 acres of land were flooded on the American side of the river, and 5,000 acres on the Mexican side; and that 75 per cent of this land was under cultivation. Between 300 and 400 houses, built of adobe, a majority of which were in El Paso and its immediate vicinity, were ruined or seriously damaged when their walls were crumbled by coming in contact with the water. A greater number of houses suffered lesser injuries. The most conservative estimates placed the total loss occasioned by the flood at $1,000,000.

The United States Reclamation Service, with project headquarters at El Paso and substations and river gages at certain points along the river, was able to follow the stages of the rise and issue adequate warnings.

There would have been far greater destruction had not dikes been prepared hastily at the weaker points along the river bank. This work was directed largely by the local officials of the United States Reclamation Service and the city engineer. The farmers and their helpers were assisted greatly in the construction of the dikes by soldiers and materials from Fort Bliss.

Since the completion of the Elephant Butte Dam in 1916, there has been a gradual rise in the bed of the river, due to the decrease in the rate of movement of the river. There is also a large horseshoe bend in the river just below El Paso which also retards the movement. The increase in elevation of the river bed at the Santa Fe Street Bridge at El Paso is now 9 feet. This induces a dangerous condition, as comparatively small rises in the river will produce overflows.

Heavy rains in the lower portion of the watershed again raised the river to above flood stage at Rio Grande City and San Benito on the 8th and 9th. Of the results of this rise, Mr. J. H. Jarboe, official in charge of the Weather Bureau office at San Antonio, Tex., reports in part as follows:

Levees, weakened by continuous rains during the month, gave way in several places and large sections of farm lands were flooded. Most crops had been harvested and the losses were mostly in delayed farm work, delayed business and transportation, and about $40,000 spent in holding and repairing levees, mostly in Cameron County.

A destructive local flood, caused by heavy rainfall over the precipitous and narrow Squillchuck Canyon and resulting in the loss of 14 lives and property damage estimated at $130,500, occurred near Wenatchee, Wash., during the afternoon of September 5. Since no rain gages are maintained in the area over which the heaviest rain fell, no data are available as to its amount; but the topography of the canyon is such that even a moderately heavy fall, if sudden enough, could readily have caused a flood of this extremely destructive type. The losses were apportioned as follows:

Railroad property	$75, 000
Highways	3, 500
Irrigation canals and ditches	4, 000
Fruit trees washed out	3, 000
Buildings, automobiles, and other property	45, 000
Total	130, 500

The high stages occurring in the Gila and Hassayampa Rivers of Arizona were without consequence; and no report of damage has been received of the moderate flood in the Grand River of Missouri on the 13th and 14th.

Low water.—Moderate rainfall during the last decade of September in the Southern States brought to an end the drought which had continued in that section since June. In addition to the widespread unfavorable effect of this drought on crops, farmlands, forests, etc., rivers fell to extremely low stages, with the result that water power failed in many sections, street-car schedules were curtailed, mill operations reduced, navigation seriously impeded, and the consumption of electricity generally curtailed. Many communities, confronted with an acute shortage of water for direct use, were compelled to ration their supplies.

The river stages were the lowest of record in many sections, and a statistical summary relative thereto appears in the following table:

Principal rivers in which low-water records were established during August-September, 1925

River and station	Low-water stage (feet)	Date (1925)	Previous low-water record (feet)	Date
Peedee: Cheraw, S. C.	−2.0	[1] Sept. 13	0.0	[1] Aug. 2, 1866
Santee: Rimini, S. C.	0.2	Sept. 9	1.0	Nov. —, 1904
Oconee: Dublin, Ga.	−2.4	[1] Sept. 7	−1.8	[1] Sept. 14, 1914
Ocmulgee:				
Hawkinsville, Ga.	0.8	Sept. 11	1.3	[1] Sept. 15, 1911
Abbeville, Ga.	−1.7	Sept. 5	−1.0	[1] June 17, 1898
Chattahoochee: Norcross, Ga.	0.6	Aug. 25	1.0	Sept. 30, 1911
Flint:				
Woodbury, Ga.	−0.9	[1] Sept. 24	−0.5	[1] Oct. 24, 1904
Albany, Ga.	−3.2	Sept. 27	−1.4	July 31, 1921
Apalachicola:				
River Junction, Fla.	[2] −1.5	[1] Sept. '24	−0.2	Nov. 30, 1922
Blountstown, Fla.	2.6	[1] Sept. 23	[3] 3.0	(4)
Coosa:				
Mayos Bar, Ga.	−2.8	Sept. 5	−0.6	Sept. 17, 1914
Wetumpka, Ala.	−2.5	Aug. 24	−2.0	Aug. 25, 1924
Alabama: Montgomery, Ala.	−4.0	Sept. 22	−3.4	Nov. 25, 1924
Pearl: Monticello, Miss.	−0.5	[1] Sept. 11	−0.3	[1] Oct. 29, 1924
Miami:				
Dayton, Ohio	−0.1	[1] Sept. 5	0.6	[1] July 27, 1923
Hamilton, Ohio	−1.4	[1] Sept. 10	−1.3	Oct. 26, 1924
Tennessee:				
Knoxville, Tenn.	−1.9	[1] Sept. 10	−1.5	Dec. 1, 1895
Guntersville, Ala.	−0.5	Sept. 29	−0.4	Nov. 18, 1924
Florence, Ala.	−2.9	[1] Sept. 25	−1.0	Nov. 27, 1924
Riverton, Ala.	4.7	Sept. 28	5.0	[1] Oct. 24, 1904
Savannah, Tenn.	−2.6	[1] Sept. 8	0.0	(4).
Johnsonville, Tenn.	−1.9	Sept. 11	−0.9	[1] Oct. 26, 1904
Arkansas:				
Tulsa, Okla.	0.4	[1] Sept. 5	1.0	[1] July 16, 1910
Little Rock, Ark.	−2.8	[1] Sept. 10	−2.4	[1] Aug. 18, 1918

[1] And subsequent dates. [2] Estimated. [3] About. [4] Date unknown.

Principal rivers in which low-water records were established during August-September, 1925—Continued

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
Mississippi drainage					
Grand:	*Feet*			*Feet*	
Gallatin, Mo.	20	13	13	21.5	13
Chillicothe, Mo.	18	13	14	21.3	14
West gulf drainage					
Rio Grande:					
Rio Grande City, Tex.	15	8	10	21.8	9
San Benito, Tex.	21	9	19	24.4	11-12
Pacific drainage					
Gila: Kelvin, Ariz.	5	2	5	7.0	4
		19	19	5.0	19
Hassayampa: Wickenburg, Ariz.	6	19	19	6.0	19

MEAN LAKE LEVELS DURING SEPTEMBER, 1925

By UNITED STATES LAKE SURVEY

[Detroit, Mich., Oct. 8, 1925]

The following data are reported in the "Notice to Mariners" of the above date:

Data	Lakes [1]			
	Superior	Michigan and Huron	Erie	Ontario
Mean level during September, 1925:	*Feet*	*Feet*	*Feet*	*Feet*
Above mean sea level at New York	601.40	578.22	570.90	244.56
Above or below—				
Mean stage of August, 1925	−0.09	−0.20	−0.18	−0.34
Mean stage of September, 1924	−0.40	−1.31	−1.05	−1.09
Average stage for September last 10 years	−1.18	−2.29	−1.43	−1.41
Highest recorded September stage	−2.68	−5.21	−3.04	−3.05
Lowest recorded September stage	−0.09	−1.31	−0.38	+0.56
Average departure (since 1860) of September level from August level	+0.05	−0.20	−0.26	−0.40

[1] Lake St. Clair's level: In September, 1925, 573.59 feet.

THE EFFECT OF WEATHER ON CROPS AND FARM OPERATIONS, SEPTEMBER, 1925

By J. B. KINCER

General summary.—During the first week in September droughty conditions prevailed over nearly all sections of the country east of the Rocky Mountains, and the continued dry weather, excessive sunshine, and, in some places, unprecedented September heat, ripened outstanding crops rapidly and prematurely in many cases. Plowing was practically suspended in most interior States and the seeding of fall grains was impossible in many sections.

During the second week of the month, however, the drought was largely broken by generous rainfall, which was especially effective in practically all the central valley States, and the soil was put in good condition. Late truck, garden crops, and pastures were much revived. In the Southeast the rainfall was insufficient to be substantially beneficial and late crops continued to deteriorate. This was especially true in the States comprising the area from Virginia southward. Damage from the frost that occurred in some central-northern districts about the middle of the month was not material, as most crops had matured.

During the last half of the month conditions remained favorable for agricultural interests in most sections, except that moisture continued largely insufficient in the Southeastern States. In some interior States field work was somewhat interrupted by too much rain near the close of the month, and the soil had become too dry in parts of the Pacific Northwest.

Small grains.—Harvesting of wheat was practically completed early in the month, and threshing was well along in the northern border States. Until about the 10th it was much too dry for plowing and the preparation of seed beds for the new wheat crop, but thereafter there was sufficient moisture for this work and good progress was reported. By the 15th plowing had been resumed generally, with seeding begun in the upper Ohio Valley and in the Plains States, and by the close of the month sowing was in full progress in much of the Wheat Belt There was some interruption by rainfall to seeding in the lower Great Plains, the lower Missouri Valley, and some upper Mississippi Valley districts. Early-seeded wheat was coming up to a good stand in many localities. Grain sorghums in the lower Great Plains showed improvement after the rains.

Corn.—This crop ripened too rapidly during the first part of the month, because of the prevailing warm, dry weather, and by the 10th about half of the crop was safe from frost in Iowa and Indiana, and the bulk of it was safe in Missouri. Late corn was benefited by rain, especially in the Southern States, but the hot, dry weather early in the month caused some deterioration in the main Corn Belt. At the close of the month the crop was nearly all safe and harvest was well advanced, though late corn was somewhat damaged by frost during the last week in some northeastern districts. On the whole, frost damage this year was negligible.

Cotton.—The first part of the month continued warm and dry and unfavorable for late cotton in nearly all portions of the South. Bolls opened very rapidly and picking and ginning made splendid progress. After the first week, showers and more moderate temperatures over the western half of the belt made much better conditions for the crop, and the late plants made fair to very good advance; there was some damage by wetness to open and unpicked cotton, but this was not extensive. In the eastern portion of the belt it continued warm, dry, and unfavorable for the development of the late crop. The third week had generally fair weather in practically all sections, which was favorable for picking and ginning, but rather widespread rains the latter part of the month caused considerable retardation in this work in the western cotton States. Harvest was well advanced for the season at the close of the month.

Miscellaneous crops.—Pastures showed general improvement east of the Rocky Mountains, except in some southeastern districts where it continued too dry. Range conditions continued favorable in the Northwest, and grazing was mostly good in the Southwest. Some livestock were moved to winter ranges in the Rocky Mountain section. Late truck and garden crops improved in the Southern States, particularly in central and west Gulf districts, and unmatured minor crops made good advance quite generally in the interior of the country. Potato harvest was in progress in the northern and and Northeastern States, with generally good returns reported from Pennsylvania and Ohio.

CLIMATOLOGICAL TABLES[1]

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections September, 1925

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	83.5	+8.2	Centerville	112	5	2 stations	59	1	2.71	−0.85	Fayette	9.87	Bridgeport	0.34
Alaska [*August*]	55.1	+1.1	Rampart	88	3	Allakaket	24	24	4.00	−0.81	Speel River	10.10	Fairbanks	0.67
Arizona	71.3	−1.9	Mohawk	111	1	Bright Angel	18	30	1.91	+0.82	Fort Valley	8.09	2 stations	0.00
Arkansas	80.5	+6.6	Helena	113	6	Harrison	47	12	5.96	+2.63	Lutherville	15.61	Princeton	0.58
California	64.5	−3.1	Greenland Ranch	111	1	Helm Creek	9	29	0.56	+0.01	McCloud	5.21	78 stations	0.00
Colorado	57.7	+0.7	Lamar	99	[2]4	Spicer	12	29	1.77	+0.41	Tacoma	4.97	Rifle	0.08
Florida	82.6	+3.6	Bonifay	107	5	Mount Pleasant	62	25	2.44	−4.30	Long Key	7.28	2 stations	0.34
Georgia	83.6	+8.6	Americus	111	5	Clayton	50	[2]26	1.57	−2.10	Blakely	4.05	Concord	0.00
Hawaii	75.0	+0.3	9 stations	92	[2]4	Waimea	52	19	4.43	−1.71	Eke	20.00	4 stations	0.00
Idaho	57.1	−0.5	Chattin's Flat	100	1	Bostetter	18	30	1.44	+0.42	Driggs	4.59	Shoshone	0.15
Illinois	73.2	+6.2	Harrisburg	109	5	Rockford	40	25	4.97	+1.46	Elgin	10.32	Windsor	1.91
Indiana	72.9	+6.2	Huntingburg	108	5	Howe	39	25	5.22	+2.22	Anderson	8.73	Evans Landing	1.58
Iowa	69.0	+4.7	2 stations	105	[2]2	Sanborn	32	21	5.04	+1.39	Washington	9.13	Storm Lake	1.54
Kansas	72.7	+3.3	Cawker City	110	18	Atwood	36	23	4.13	+1.30	Parsons	10.42	Norton	0.26
Kentucky	77.3	+7.0	Beaver Dam	110	6	Farmers	45	30	2.84	+0.03	Owensboro	6.36	Sergent	0.70
Louisiana	81.9	+4.2	2 stations	110	[2]7	Minden	61	26	5.69	+1.69	Pharr	12.23	Minden	2.16
Maryland-Delaware	71.6	+4.2	3 stations	100	12	2 stations	35	26	1.69	−1.53	State Sanatorium, Md.	3.84	Dover, Del	0.35
Michigan	62.3	+2.4	Hartford	99	5	Sidnaw	18	18	3.69	+0.67	Albion	7.47	Saint James	1.64
Minnesota	61.3	+2.9	2 stations	103	[2]3	Pine River Dam	18	22	4.19	+1.38	Waskish	8.77	New London	0.89
Mississippi	83.4	+7.5	Pontotoc	111	7	3 stations	60	[2]2	2.99	−0.24	Stoneville	7.39	Collins	0.97
Missouri	74.6	+5.6	Jackson	110	6	Unionville	45	21	6.46	+2.73	Lockwood	14.55	Warrenton	2.39
Montana	55.1	−0.3	2 stations	99	3	Adel	10	20	2.38	+0.87	Adel	6.10	Libby	0.70
Nebraska	67.6	+3.7	2 stations	104	[2]2	2 stations	28	[2]20	1.81	−0.32	Tekemah	5.16	Ord	0.30
Nevada	59.2	−2.9	Las Vegas	102	1	Rye Patch	13	30	0.79	+0.34	Lamoille	3.48	2 stations	0.00
New England	59.4	−0.1	Lewiston, Me	92	12	Garfield, Vt	20	26	4.08	+0.35	Enosburg Falls, Vt	8.36	Concord, N. H	1.67
New Jersey	67.8	+2.1	Phillipsburg	96	13	Charlotteburg	25	26	2.92	−0.71	Belvidere	5.81	Vineland	0.64
New Mexico	64.0	−0.3	3 stations	97	[2]15	Lee's Ranch	18	24	1.98	+0.45	Abbott	7.47	Columbus	0.03
New York	61.7	+0.6	Port Jervis	95	11	Gabriels	20	26	4.90	+1.49	Brockport	8.10	Mount Hope	1.55
North Carolina	76.3	+6.2	Rockingham	108	4	Parker	38	30	2.03	−1.96	Lumberton	4.99	Charlotte	0.19
North Dakota	58.1	+1.7	Fessenden	103	3	Linton	20	28	2.74	+1.10	Mayville	7.26	Dickinson	0.46
Ohio	70.1	+4.6	2 stations	101	9	Canfield	36	22	3.76	+0.90	Greenville	9.32	Marietta Experiment Farm.	0.60
Oklahoma	76.4	+2.6	2 stations	107	[2]6	Kenton	44	[2]25	5.80	+3.25	Walters	11.56	Jefferson	1.79
Oregon	58.8	−0.2	Echo	100	3	Fremont	13	30	1.57	+0.23	Crater Lake	5.17	Lapine	0.09
Pennsylvania	67.5	+3.9	2 stations	99	[2]11	West Bingham	24	23	2.80	−0.59	Penn Line	7.63	Huntingdon	0.86
Porto Rico	79.0	+0.1	4 stations	98	[2]10	Jayuya	59	21	7.46	−0.53	Maricao	19.70	Santa Isabel	2.15
South Carolina	81.7	+7.3	2 stations	111	[2]4	Liberty	55	[2]1	1.86	−2.14	Mars Bluff	5.55	Aiken	0.24
South Dakota	65.1	+4.3	Menno	108	3	Wood	23	22	1.10	−0.67	Victor	4.48	2 stations	T
Tennessee	79.8	+8.9	Clarksville	112	7	Crossville	46	30	2.54	−0.52	Johnsonville	6.52	Decatur	0.42
Texas	79.2	+2.0	2 stations	108	7	Clint	41	27	4.41	+1.53	Brownsville	19.21	Plains	0.04
Utah	59.1	−1.1	Saint George	97	15	Ibapah	17	30	1.47	+0.37	Hole-in-the-Rock	4.35	Big Plains	0.25
Virginia	73.4	+5.3	Troy	102	7	Ashland	35	26	1.71	−1.58	Clarksville	3.68	Dahlgren	0.24
Washington	59.3	+0.6	Omak	98	3	Waterville	24	30	0.91	−0.62	Vancouver	4.46	Lakeside	0.04
West Virginia	70.9	+5.0	3 stations	102	[2]11	3 stations	34	26	2.29	−0.73	Kanawha Falls	5.89	Wayne	0.50
Wisconsin	63.0	+3.4	3 stations	100	4	Long Lake	18	25	4.67	+1.18	Deerskin Dam	7.91	Sturgeon Bay	1.03
Wyoming	55.5	+0.7	Pinebluff	96	2	Foxpark	17	30	1.37	+0.11	Snake River	3.67	2 stations	T

[1] For description of tables and charts, see REVIEW, January, 1925, p. 42.

[2] Other data also.

TABLE 1.—*Climatological data for Weather Bureau stations, September, 1925*

Districts and stations	Elevation or instruments: Barometer above sea level	Elevation or instruments: Thermometer above ground	Elevation or instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. +2 mean min. ÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	*In.*	*In.*		*Miles.*							*0–10*	*In.*	*In.*
New England							**60.5**	**−0.3**										**79**	**2.98**	**−0.2**										**5.3**		
Eastport	76	67	85	29.92	30.00	−0.03	54.0	−1.8	78	1	61	37	23	47	36	50	48	84	3.22	+0.2	17	6,311	s.	35	nw.	25	6	9	15	6.7	0.0	0.0
Greenville, Me	1,070	6	....	28.86	30.02	.....	52.7	.....	84	11	62	29	23	43	33	.....	.....	.....	4.24	.....	15	4,377	nw.	.....	.....	.....	6	11	13	.....	0.0	0.0
Portland, Me	103	82	117	29.93	30.05	.00	58.6	−1.0	84	1	66	37	26	51	27	53	49	75	1.75	−1.4	11	6,210	nw.	40	nw.	12	12	7	11	5.2	0.0	0.0
Concord	288	70	79	29.72	30.03	−.03	58.8	−0.5	88	12	70	27	26	48	41	.....	.....	.....	1.67	−1.5	12	3,514	nw.	24	nw.	25	12	9	9	4.8	0.0	0.0
Burlington	404	11	48	29.59	30.02	−.04	57.6	−2.7	85	11	66	30	26	49	32	.....	.....	.....	5.90	+2.6	13	7,480	s.	52	s.	20	5	10	15	7.1	0.0	0.0
Northfield	876	12	60	29.10	30.05	−.01	54.8	−1.3	87	11	66	25	26	44	40	51	49	86	4.20	+1.4	13	4,610	s.	25	n.	24	6	10	14	6.7	0.0	0.0
Boston	125	115	188	29.91	30.04	−.03	64.0	+0.8	90	11	72	41	26	56	26	57	53	74	3.45	+0.3	7	6,395	sw.	27	w.	25	11	12	7	5.1	0.0	0.0
Nantucket	12	14	90	30.02	30.03	−.05	62.8	0.0	81	1	68	47	30	57	18	59	56	83	2.05	−0.7	7	11,031	sw.	33	n.	25	12	9	9	5.4	0.0	0.0
Block Island	26	11	46	30.00	30.04	−.04	64.0	+0.6	79	1	69	46	26	59	19	60	57	82	2.04	−1.0	8	10,651	sw.	46	nw.	25	11	11	8	4.9	0.0	0.0
Providence	160	215	251	29.87	30.04	−.03	63.0	−0.2	84	11	71	37	26	55	26	57	53	73	2.58	−0.6	9	8,050	nw.	39	nw.	21	9	13	8	5.2	0.0	0.0
Hartford	159	122	140	29.87	30.05	−.02	63.4	+1.9	85	11	72	34	26	54	32	.....	.....	.....	2.39	−1.1	10	.....	s.	.....	.....	.....	13	8	9	4.7	0.0	0.0
New Haven	106	74	153	29.93	30.04	−.03	64.4	+0.9	83	5	72	37	26	57	25	59	56	76	3.49	−0.3	9	6,438	n.	26	s.	20	14	10	6	4.0	0.0	0.0
Middle Atlantic States							**70.1**	**+3.3**										**77**	**2.14**	**−1.3**										**5.5**		
Albany	97	102	115	29.92	30.03	−.04	62.7	−0.4	87	11	71	34	26	54	31	59	56	85	3.43	+0.2	14	5,277	s.	36	s.	20	7	12	11	5.6	0.0	0.0
Binghamton	871	10	84	29.11	30.04	−.03	62.6	+1.3	91	12	72	32	23	53	35	.....	.....	.....	4.99	+2.2	12	3,440	nw.	30	sw.	13	5	9	16	6.9	0.0	0.0
New York	314	414	454	29.71	30.04	−.04	67.5	+0.7	86	12	74	49	23	61	24	61	56	72	1.87	−1.7	8	10,551	n.	42	n.	21	2	18	10	6.3	0.0	0.0
Harrisburg	374	94	104	29.65	30.06	−.03	69.7	+3.9	94	12	79	43	26	61	27	62	57	69	1.92	−0.9	7	4,155	ne.	31	sw.	13	5	17	8	5.6	0.0	0.0
Philadelphia	114	123	190	29.92	30.04	−.04	71.2	+3.2	91	13	79	48	23	63	23	63	58	69	1.89	−1.5	7	6,354	n.	24	s.	20	5	16	9	5.9	0.0	0.0
Reading	325	81	98	29.69	30.04	.....	69.4	.....	92	12	79	40	26	60	30	63	60	77	2.53	−1.1	7	3,849	se.	26	se.	15	9	10	11	6.0	0.0	0.0
Scranton	805	111	119	29.19	30.05	−.02	64.2	+1.3	89	12	74	34	23	54	34	60	59	89	2.26	−0.6	11	4,166	n.	50	n.	13	5	11	14	6.6	0.0	0.0
Atlantic City	52	37	172	29.98	30.03	−.04	70.0	+3.2	88	21	76	52	26	64	25	65	62	78	1.05	−2.0	11	10,793	s.	39	s.	13	10	15	5	4.4	0.0	0.0
Cape May	17	13	49	30.05	30.07	.00	71.0	+2.0	88	21	78	47	26	64	25	66	64	84	2.12	−0.9	7	4,244	s.	15	se.	27	13	11	6	4.5	0.0	0.0
Sandy Hook	22	10	55	30.01	30.02	.....	68.5	.....	86	1	74	51	23	63	20	62	59	75	2.10	.....	...	9,964	s.	45	n.	21	6	16	8	5.4	0.0	0.0
Trenton	190	159	183	29.83	30.03	.....	68.6	.....	91	13	78	43	30	60	27	62	59	76	3.91	+0.3	9	6,987	n.	30	w.	13	4	16	10	6.5	0.0	0.0
Baltimore	123	100	113	29.90	30.02	−.06	73.4	+4.9	92	11	81	49	26	66	28	65	62	72	0.75	−3.1	6	4,022	s.	17	se.	27	8	14	8	5.4	0.0	0.0
Washington	112	62	85	29.91	30.02	−.06	72.8	+4.7	94	11	82	46	26	64	31	65	62	74	3.05	−0.5	11	3,594	n.	28	n.	6	9	11	10	5.7	0.0	0.0
Cape Henry	18	8	54	30.00	30.02	.....	74.6	.....	90	14	81	62	24	68	19	69	67	82	1.09	−3.0	7	8,216	sw.	38	ne.	22	15	8	7	4.3	0.0	0.0
Lynchburg	681	153	188	29.31	30.04	−.04	74.6	+5.6	99	4	85	51	23	64	34	65	62	72	0.43	−3.2	8	3,992	w.	34	w.	10	11	14	5	4.9	0.0	0.0
Norfolk	91	170	205	29.94	30.04	−.02	75.4	+3.8	91	10	83	58	24	68	23	68	66	81	2.66	−1.4	6	7,640	s.	36	se.	15	14	6	10	4.7	0.0	0.0
Richmond	144	11	52	29.89	30.04	−.03	75.4	+4.9	98	7	86	50	26	65	31	67	64	77	0.93	−2.5	8	4,932	sw.	24	s.	13	11	14	5	4.8	0.0	0.0
Wytheville	2,304	49	55	27.72	30.03	−.04	71.2	+7.6	93	6	82	52	18	60	37	62	59	74	1.49	−1.8	8	3,151	w.	20	sw.	10	6	18	6	5.7	0.0	0.0
South Atlantic States							**80.4**	**+7.0**										**76**	**2.02**	**−2.6**										**4.4**		
Asheville	2,255	70	84	27.75	30.03	−.04	73.0	+8.6	95	7	85	56	18	63	33	64	60	74	1.92	−1.0	7	3,884	se.	33	se.	9	9	12	9	5.2	0.0	0.0
Charlotte	779	55	62	29.21	30.02	−.05	80.5	+9.0	100	7	92	60	23	69	31	68	64	66	0.19	−3.0	4	2,686	ne.	18	nw.	10	12	14	4	4.6	0.0	0.0
Hatteras	11	11	50	30.01	30.02	−.04	77.6	+3.1	89	4	83	67	24	72	17	72	70	80	0.95	−4.4	10	8,668	sw.	29	nw.	17	15	10	5	3.8	0.0	0.0
Raleigh	376	103	110	29.64	30.02	−.05	77.0	+5.9	100	4	87	56	26	67	27	69	66	77	4.36	+1.0	5	4,669	s.	31	n.	1	11	11	8	4.9	0.0	0.0
Wilmington	78	81	91	29.95	30.03	−.02	78.8	+5.7	100	4	87	60	30	70	24	73	71	84	1.78	−3.5	6	4,457	sw.	23	nw.	16	12	16	2	4.4	0.0	0.0
Charleston	48	11	92	29.97	30.02	−.02	82.2	+5.6	95	19	88	69	1	76	18	77	75	84	1.94	−3.5	7	6,462	sw.	36	e.	29	5	15	10	5.9	0.0	0.0
Columbia, S. C	351	41	57	29.65	30.02	−.03	82.6	+8.1	106	4	93	65	1	72	30	71	68	71	1.90	−1.6	7	4,115	s.	36	sw.	14	9	17	4	4.3	0.0	0.0
Due West	711	10	55	29.29	30.05	.....	81.8	.....	105	8	94	63	27	70	32	.....	.....	.....	2.26	.....	5	5,008	ne.	38	sw.	23	16	9	5	3.9	0.0	0.0
Greenville, S. C	1,039	113	122	28.94	30.01	.....	80.4	+9.8	100	7	91	64	27	70	29	68	63	64	2.35	.....	7	3,909	n.	31	nw.	22	16	8	6	4.2	0.0	0.0
Augusta	182	62	77	29.80	30.00	−.05	84.7	+9.4	106	4	96	66	1	73	34	73	69	70	0.86	−2.8	5	3,220	e.	48	nw.	7	16	11	3	4.2	0.0	0.0
Savannah	65	150	194	29.93	30.00	−.03	83.6	+7.4	102	4	92	69	30	75	28	75	74	83	3.91	−1.6	5	6,953	sw.	29	e.	26	17	9	4	3.5	0.0	0.0
Jacksonville	43	209	245	29.96	30.01	+.01	83.2	+4.9	96	5	91	69	30	75	21	75	73	80	2.41	−5.6	7	6,859	sw.	43	se.	27	16	11	3	3.8	0.0	0.0
Florida Peninsula							**82.6**	**+1.4**										**76**	**3.74**	**−3.9**										**4.2**		
Key West	22	10	64	29.94	29.96	+.02	82.5	+0.3	90	8	88	71	16	77	16	76	74	77	6.22	−0.6	14	6,098	e.	27	s.	15	13	11	6	4.3	0.0	0.0
Miami	25	71	79	29.97	30.00	.....	82.2	+0.7	90	19	87	73	15	77	15	76	73	74	2.73	−6.0	12	4,167	e.	41	se.	14	14	12	4	4.1	0.0	0.0
Tampa	35	79	87	29.96	29.98	+.01	83.2	+3.3	95	7	92	71	14	75	20	75	73	78	2.26	−5.2	11	3,424	e.	28	ne.	26	11	16	3	4.5	0.0	0.0
Titusville	44	5	....	29.96	30.00	.....	82.2	.....	98	22	90	68	20	74	25	.....	.....	.....	3.18	.....	6	.....	sw.	.....	.....	.....	.....	.....	.....	15	7	8	4.0	0.0	0.0
East Gulf States							**83.6**	**+7.9**										**71**	**1.85**	**−2.0**										**3.9**		
Atlanta	1,174	190	216	28.81	30.02	−.03	83.0	+10.6	102	8	93	66	30	73	27	68	62	57	0.24	−3.3	3	6,024	nw.	48	nw.	16	14	7	9	4.7	0.0	0.0
Macon	370	78	87	29.61	30.00	−.03	84.0	+9.2	105	8	96	63	1	72	31	71	65	62	1.79	−1.6	6	3,521	s.	25	se.	28	16	10	4	3.7	0.0	0.0
Thomasville	273	49	58	29.71	30.00	−.01	84.6	+7.8	106	5	96	69	2	74	30	74	72	77	0.88	−3.4	5	2,766	sw.	15	sw.	20	7	18	5	5.1	0.0	0.0
Apalachicola	36	42	49	29.95	29.99	.....	82.8	.....	96	5	88	70	29	77	17	77	75	82	1.42	.....	2	4,875	sw.	37	ne.	26	22	6	2	2.8	0.0	0.0
Pensacola	56	149	185	29.94	30.00	+.01	83.0	+5.0	102	5	89	74	12	77	24	76	74	81	1.23	−4.0	6	7,764	s.	33	sw.	12	20	5	5	3.5	0.0	0.0
Anniston	741	9	57	29.26	30.04	+.01	82.2	+10.9	105	5	96	64	1	68	37	.....	.....	.....	1.30	−2.2	7	2,632	s.	54	e.	10	21	9	0	2.9	0.0	0.0
Birmingham	700	11	48	29.27	30.02	−.01	84.2	+9.4	106	5	96	69	27	72	31	70	65	63	0.66	−2.8	6	3,583	s.	28	se.	26	16	9	5	3.9	0.0	0.0
Mobile	57	125	161	29.93	29.99	−.01	83.7	+5.6	103	5	92	71	12	76	25	75	73	79	1.34	−3.7	4	5,659	sw.	29	se.	26	15	8	7	4.4	0.0	0.0
Montgomery	223	100	112	29.76	30.00	−.02	84.5	+8.2	106	5	95	68	2	74	31	71	67	65	1.65	−1.2	8	3,617	sw.	36	n.	7	18	8	4	3.4	0.0	0.0
Corinth	469	6	....	.....	.....	.....	83.3	.....	106	9	96	63	30	71	36	.....	.....	.....	2.12	.....	6	.....	s.	.....	.....	.....	6	23	1	.....	0.0	0.0
Meridian	375	85	93	29.60	29.98	−.04	83.2	+8.7	104	6	94	65	1	72	30	72	68	69	1.54	−1.9	5	2,867	s.	19	e.	7	18	9	3	3.5	0.0	0.0
Vicksburg	247	65	73	29.72	30.00	−.02	84.0	+7.7	104	6	94	70	26	74	25	72	68	69	2.55	−0.8	7	3,492	sw.	24	sw.	25	10	12	8	4.6	0.0	0.0
New Orleans	53	76	84	29.93	29.98	.00	83.2	+4.0	98	6	91	69	26	75	21	75	73	79	7.13	+3.2	10	3,519	se.	30	se.	26	16	5	9	4.3	0.0	0.0
West Gulf States							**80.9**	**+4.0**										**75**	**4.71**	**+1.3**										**4.9**		
Shreveport	249	77	93	29.70	29.96	−.04	83.2	+6.3	105	7	93	66	26	73	25	72	67	68	2.40	−0.8	5	4,034	se.	19	s.	14	20	4	6	3.5	0.0	0.0
Bentonville	1,303	11	44	.....	.....	.....	75.6	+6.7	100	7	86	54	13	65	35	.....	.....	.....	5.79	.....	9	2,958	sw.	15	w.	10	18	7	5	.....	0.0	0.0
Fort Smith	457	79	94	29.47	29.94	−.07	79.8	+5.8	104	7	90	60	13	69	33	69	65	69	7.52	+4.4	8	4,211	e.	54	sw.	10	13	11	6	4.3	0.0	0.0
Little Rock	357	136	144	29.59	29.95	−.08	81.9	+7.8	104	7	92	65	24	72	29	70	64	64	3.38	+0.1	8	4,180	s.	26	s.	10	16	7	7	3.9	0.0	0.0
Brownsville	57	53	61	29.83	29.89	.....	80.7	+0.1	94	4	87	68	25	75	19	75	74	87	19.21	.....	21	4,335	s.	43	s.	7	7	11	12	6.1	0.0	0.0
Corpus Christi	20	11	73	29.91	29.93	−.02	81.2	+1.5	90	4	86	66	26	76	18	76	74	83	8.12	+4.1	18	8,090	se.	41	se.	7	7	13	10	5.8	0.0	0.0
Dallas	512	109	117	29.42	29.96	.....	82.4	.....	101	7	92	62	26	73	22	.....	.....	.....	3.78	.....	6	4,749	s.	28	se.	10	16	7	7	4.1	0.0	0.0
Fort Worth	670	106	114	29.23	29.93	−.06	82.0	+5.1	100	6	91	61	26	73	25	70	64	61	1.79	−0.7	7	6,174	s.	34	s.	10	13	13	4	4.5	0.0	0.0
Galveston	54	106	114	29.92	29.98	.00	81.0	+0.9	90	22	85	69	12	77	16	76	74	83	11.06	+5.6	15	6,648	s.	34	n.	12	12	7	11	5.2	0.0	0.0
Groesbeck	461	11	56	29.47	29.94	.....	81.0	.....	100	7	91	62	26	71	28	.....	.....	.....	5.76	.....	6	5,176	s.	32	ne.	11	12	15	3	4.3	0.0	0.0
Houston	138	111	121	29.82	29.96	.....	81.2	+2.2	95	22	89	67	25	74	22	.....	.....	.....	3.41	.....	11	4,168	se.	24	n.	12	14	7	9	5.1	0.0	0.0
Palestine	510	64	72	29.44	29.96	−.03	81.6	+4.6	101	7	91	64	26	72	25	71	68	71	2.43	−0.8	6	4,166	s.	24	s.	10	5	21	4	5.0	0.0	0.0
Port Arthur	34	58	66	29.92	29.96	.....	81.8	.....	94	7	88	68	12	75	19	75	74	84	11.34	.....	9	4,754	se.	26	n.	12	16	2	12	4.8	0.0	0.0
San Antonio	693	119	132	29.23	29.94	−.02	80.8	+1.8	96	5	89	61	26	72	25	72	69	76	2.87	−0.1	10	4,846	s.	27	ne.	24	1	18	11	6.2	0.0	0.0
Taylor	583	55	63	29.38	29.99	+.02	81.7	+4.8	98	6	92	61	26	72	25	.....	.....	.....	2.86	−0.2	10	5,250	s.	32	ne.	1	8	17	5	5.2	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, September, 1925*—Continued

Districts and stations	Elevation or instruments: Barometer above sea level	Elevation or instruments: Thermometer above ground	Elevation or instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	*In.*	*In.*		*Miles.*								*0–10*	*In.*	*In.*
Ohio Valley and Tennessee							**75.9**	**+7.2**										**69**	**3.19**	**+0.4**										**5.3**		
Chattanooga	762	189	213	29.20	29.99	−0.07	82.8	+10.6	104	5	94	63	30	71	31	68	61	57	1.80	−1.4	4	4,473	sw.	37	sw.	9	15	12	3	4.1	0.0	0.0
Knoxville	996	102	111	28.98	30.01	−.05	79.7	+9.1	102	7	91	62	30	68	33	68	64	68	2.48	−0.3	9	3,073	ne.	26	sw.	14	15	11	4	3.9	0.0	0.0
Memphis	399	76	97	29.56	29.97	−.06	83.0	+9.4	103	6	92	66	24	74	24	71	66	64	1.77	−1.3	7	3,966	sw.	27	sw.	25	18	3	9	3.8	0.0	0.0
Nashville	546	168	191	29.44	30.01	−.05	81.4	+9.6	104	7	92	62	30	71	31	69	64	64	3.52	−0.2	12	4,975	w.	31	sw.	11	13	12	5	4.4	0.0	0.0
Lexington	989	193	230	28.98	30.02	−.05	76.2	+7.7	99	9	86	52	23	67	31	----	----	----	1.70	−0.7	11	8,044	sw.	35	sw.	20	9	10	11	5.7	0.0	0.0
Louisville	525	188	234	29.44	30.02	−.04	77.5	+7.0	101	9	87	56	23	68	33	66	62	66	2.14	−0.5	9	6,152	ne.	37	sw.	20	14	8	8	4.8	0.0	0.0
Evansville	431	139	175	29.54	30.00	−.06	78.2	+7.5	104	6	88	55	23	68	29	68	64	69	6.20	+3.5	12	6,285	sw.	43	nw.	8	7	15	8	5.3	0.0	0.0
Indianapolis	822	194	230	29.13	30.00	−.06	73.2	+6.3	95	6	82	50	23	64	27	64	61	72	5.96	+2.9	13	7,275	sw.	44	w.	6	10	11	9	5.3	0.0	0.0
Royal Center	736	11	55	29.21	30.00	------	69.6	------	97	6	80	44	25	59	39	----	----	----	6.08	------	13	6,382	e.	36	w.	6	7	7	16	6.4	0.0	0.0
Terre Haute	575	96	129	29.38	29.98	------	74.6	------	100	6	84	52	25	65	28	65	61	73	6.05	------	13	5,665	s.	42	nw.	8	5	20	5	5.3	0.0	0.0
Cincinnati	627	11	51	29.34	30.01	−.06	73.9	+6.8	98	9	84	50	23	64	30	----	62	71	3.67	+1.4	11	4,167	ne.	26	ne.	18	10	12	8	5.1	0.0	0.0
Columbus	822	179	222	29.16	30.02	−.05	71.8	+5.3	95	3	81	48	23	62	29	63	60	72	2.21	−0.3	8	6,030	e.	32	w.	15	7	10	13	6.2	0.0	0.0
Dayton	899	137	173	29.06	30.00	------	72.6	+6.0	97	3	82	49	23	63	30	64	60	72	6.47	+4.0	9	5,434	ne.	31	n.	18	11	13	6	5.0	0.0	0.0
Elkins	1,947	59	67	28.05	30.06	−.02	68.0	+5.0	91	11	80	47	25	56	36	61	59	86	4.55	+1.7	12	2,326	nw.	20	s.	12	4	18	8	6.5	0.0	0.0
Parkersburg	637	77	82	29.39	30.04	−.04	74.0	+6.7	98	11	85	54	23	63	35	63	58	66	0.55	−2.2	6	2,964	n.	18	sw.	20	12	9	9	5.2	0.0	0.0
Pittsburgh	842	353	410	29.14	30.03	−.05	70.6	+4.2	95	11	80	48	22	62	27	62	58	72	1.58	−0.9	6	6,584	nw.	39	nw.	20	1	9	20	7.6	0.0	0.0
Lower Lake Region							**64.8**	**+1.8**										**77**	**5.10**	**+2.3**										**6.6**		
Buffalo	767	247	280	29.20	30.03	−.03	62.4	0.0	85	11	69	40	26	56	32	59	57	84	5.61	+2.4	13	9,494	sw.	56	w.	24	4	11	15	7.2	0.0	0.0
Canton	448	10	61	29.52	29.99	------	57.8	−1.5	87	11	68	29	26	48	38	----	----	----	6.03	+3.2	15	5,901	sw.	39	sw.	24	7	14	9	5.6	0.0	0.0
Oswego	335	76	91	------	30.01	------	61.3	+0.1	87	11	69	34	26	54	34	----	----	79	7.04	+4.2	17	----	s.	30	n.	13	4	12	14	----	0.0	0.0
Rochester	523	86	102	29.47	30.04	−.02	63.0	+0.6	90	11	70	40	23	56	36	57	54	76	6.18	+3.9	14	4,778	sw.	30	w.	11	3	14	13	7.1	0.0	0.0
Syracuse	597	97	113	29.40	30.04	−.03	61.8	+0.2	87	11	70	35	26	54	32	----	----	----	3.25	+0.4	17	6,734	s.	39	s.	20	5	11	14	6.9	0.0	0.0
Erie	714	130	166	29.25	30.01	−.05	66.2	+2.6	92	11	73	42	23	59	31	61	58	80	5.73	+2.2	10	8,820	n.	43	w.	20	3	15	12	6.5	0.0	0.0
Cleveland	762	190	201	29.21	30.02	−.04	67.2	+3.3	90	11	74	47	23	61	26	61	57	74	5.62	+2.4	12	8,303	n.	48	sw.	11	3	11	16	7.2	0.0	0.0
Sandusky	629	62	70	29.34	30.02	−.04	68.6	+3.3	94	11	76	46	23	62	29	----	----	----	3.59	+0.9	9	5,470	sw.	27	n.	13	3	12	15	6.8	0.0	0.0
Toledo	628	206	243	29.35	30.03	−.03	68.2	+3.8	92	4	76	46	25	61	28	61	57	74	3.43	+1.1	10	8,354	sw.	39	sw.	20	10	9	11	5.6	0.0	0.0
Fort Wayne	856	113	124	29.10	30.01	------	70.2	+4.7	96	5	79	46	25	61	31	62	58	74	4.11	------	12	5,754	sw.	29	sw.	11	5	14	11	5.9	0.0	0.0
Detroit	730	218	258	29.25	30.03	−.03	66.0	+2.5	89	9	73	47	22	59	29	59	56	75	4.54	+2.1	15	5,941	e.	30	sw.	11	6	8	16	6.8	0.0	0.0
Upper Lake Region							**62.0**	**+2.1**										**80**	**3.77**	**+0.5**										**6.2**		
Alpena	609	13	92	29.37	30.03	.00	58.5	+0.9	87	20	67	36	25	50	35	55	53	83	2.91	−0.6	13	7,687	nw.	42	w.	20	5	10	15	6.7	0.0	0.0
Escanaba	612	54	60	29.35	30.01	.00	58.8	+1.7	79	3	67	32	25	50	31	54	52	81	3.43	−0.2	12	6,623	s.	35	nw.	20	11	8	11	5.3	0.0	0.0
Grand Haven	632	54	89	29.32	29.99	−.05	63.8	+2.9	85	4	72	43	25	56	27	59	57	81	4.01	+0.8	15	6,594	e.	29	s.	17	8	10	12	6.1	0.0	0.0
Grand Rapids	707	70	87	29.25	30.02	−.03	66.2	+3.5	94	4	75	44	25	58	31	59	56	75	4.35	+1.2	14	3,591	e.	24	w.	9	4	11	15	6.9	0.0	0.0
Houghton	668	62	99	29.27	29.99	−.01	57.2	+0.3	83	17	65	33	25	49	27	----	----	----	4.56	+1.0	9	7,006	e.	60	w.	20	8	9	13	6.2	0.0	0.0
Lansing	878	11	62	29.08	30.01	------	64.6	+3.2	93	4	75	40	23	55	35	59	58	86	3.88	+1.2	15	3,089	e.	18	w.	20	8	10	12	6.0	0.0	0.0
Ludington	637	60	66	29.32	30.01	------	61.8	------	85	4	69	39	25	54	26	57	55	80	2.11	------	13	6,591	e.	31	s.	17	9	12	9	5.4	0.0	0.0
Marquette	734	77	111	29.21	30.01	+.01	58.2	+0.7	88	17	66	33	25	50	29	53	50	78	3.90	+0.4	12	6,632	s.	43	sw.	20	5	12	13	6.5	0.0	0.0
Port Huron	638	70	120	29.33	30.02	−.04	63.2	+1.5	86	20	70	43	23	56	28	58	55	79	3.49	+0.8	11	6,860	ne.	32	w.	20	5	16	9	5.8	0.0	0.0
Saginaw	641	69	77	29.33	30.02	------	63.8	+2.0	91	4	73	40	23	54	32	----	----	----	3.12	------	10	----	nw.	----	----	----	----	----	----	----	0.0	0.0
Sault Ste. Marie	614	11	52	29.34	30.03	+.01	56.6	+1.1	81	20	66	30	25	48	33	52	49	82	3.35	−0.1	13	5,162	se.	47	nw.	20	7	12	11	6.0	0.0	0.0
Chicago	823	140	310	29.12	29.99	−.05	70.2	+3.9	95	5	76	54	25	64	22	63	59	72	3.19	+0.2	12	7,324	e.	35	w.	11	6	11	13	6.4	0.0	0.0
Green Bay	617	109	141	29.33	29.99	−.03	62.8	+2.4	90	4	72	37	25	54	28	57	55	81	3.38	+0.3	9	6,636	s.	40	sw.	20	6	13	11	6.1	0.0	0.0
Milwaukee	681	125	139	29.26	30.00	−.03	67.0	+4.5	90	2	74	49	21	60	27	61	58	76	4.79	+1.9	13	7,864	ne.	36	se.	30	4	14	12	6.7	0.0	0.0
Duluth	1,133	5	47	28.77	29.99	+.01	56.4	+1.3	89	17	64	33	21	49	35	53	52	91	3.73	+0.2	14	8,810	ne.	47	ne.	29	7	9	14	6.3	0.0	0.0
North Dakota							**58.2**	**+1.0**										**74**	**3.21**	**+1.8**										**5.7**		
Moorhead	940	50	58	28.92	29.93	−.03	60.6	+2.4	98	3	71	29	21	50	39	54	51	77	2.88	+0.6	14	5,599	s.	44	sw.	1	6	6	18	6.7	0.0	0.0
Bismarck	1,674	8	57	28.21	29.98	+.04	59.8	+1.7	98	3	72	29	21	48	43	51	46	68	0.85	−0.3	10	6,134	e.	34	w.	19	15	6	9	4.4	0.0	0.0
Devils Lake	1,478	11	44	28.38	29.95	+.01	56.2	+0.6	92	3	67	32	21	46	38	50	47	80	6.63	+5.2	13	6,538	ne.	40	ne.	29	9	9	12	5.5	0.0	0.0
Ellendale	1,457	10	56	28.40	29.95	------	60.4	------	95	1	72	32	21	49	39	----	----	----	3.01	------	10	8,183	ne.	58	nw.	4	5	14	11	6.1	0.0	0.0
Grand Forks	835	12	89	------	------	------	58.0	------	85	2	68	33	22	48	36	52	----	----	4.73	------	12	------	nw.	40	nw.	20	12	6	12	6.0	0.0	0.0
Williston	1,878	41	48	27.98	29.95	+.02	56.0	−0.6	92	3	67	30	21	45	41	49	44	72	2.47	+1.6	10	5,046	ne.	28	nw.	16	13	3	14	5.5	0.0	0.0
Upper Mississippi Valley							**70.5**	**+5.3**										**75**	**5.11**	**+1.8**										**5.9**		
Minneapolis	918	102	208	28.96	29.93	------	65.8	+4.4	98	4	75	39	21	56	32	----	----	----	3.35	−0.3	10	7,345	se.	40	e.	30	6	9	15	6.4	0.0	0.0
St. Paul	837	236	261	29.04	29.94	−.05	65.2	+3.9	95	2	75	39	21	56	33	----	----	----	3.49	+0.1	9	8,062	se.	45	w.	20	6	16	8	6.0	0.0	0.0
La Crosse	714	11	48	29.20	29.96	−.05	66.2	+4.0	96	2	76	42	23	56	32	----	----	----	7.15	+3.0	12	2,646	se.	20	sw.	19	8	12	10	5.8	0.0	0.0
Madison	974	70	78	28.96	29.99	−.04	65.9	+3.5	94	4	74	42	25	58	29	60	57	79	4.50	+1.3	13	5,426	se.	25	ne.	12	9	8	13	6.2	0.0	0.0
Wausau	1,247	4	----	28.68	30.01	------	60.8	----	88	3	70	34	25	51	31	----	----	----	4.87	------	12	----	e.	----	----	----	3	8	19	7.5	0.0	0.0
Charles City	1,015	10	49	28.90	29.97	−.03	66.5	+5.5	97	4	77	40	21	56	36	59	56	76	3.59	+0.8	12	4,271	se.	32	w.	19	12	10	8	4.5	0.0	0.0
Davenport	606	71	79	29.32	29.97	−.06	70.2	+4.6	98	4	79	49	21	61	31	63	60	76	3.16	+5.0	14	4,489	e.	28	nw.	8	7	10	13	6.4	0.0	0.0
Des Moines	861	84	97	29.05	29.94	−.08	70.4	+4.8	99	5	80	47	23	61	30	62	59	74	3.75	+0.7	12	4,850	sw.	40	sw.	19	8	9	13	6.0	0.0	0.0
Dubuque	700	81	96	29.22	29.96	−.07	67.8	+2.8	97	4	77	46	25	59	34	61	58	77	4.16	+0.6	14	3,823	s.	25	se.	30	8	8	14	6.5	0.0	0.0
Keokuk	614	64	78	29.30	29.96	−.07	72.8	+5.3	100	4	82	52	21	64	28	65	61	74	6.99	+3.0	10	4,370	ne.	44	w.	10	7	8	15	6.3	0.0	0.0
Cairo	358	87	93	29.60	29.97	−.08	78.4	+6.9	104	5	88	60	23	69	30	69	66	75	6.21	+3.7	13	4,316	s.	33	w.	9	8	11	11	5.8	0.0	0.0
Peoria	609	11	45	29.33	29.99	−.05	71.6	+7.3	99	6	82	50	24	62	37	64	61	79	4.99	+1.9	12	3,581	ne.	27	n.	8	9	11	10	5.6	0.0	0.0
Springfield, Ill	636	10	91	29.29	29.96	−.09	74.2	+6.6	100	6	84	52	25	64	31	65	62	76	4.45	+1.1	12	4,801	w.	25	w.	9	12	6	12	5.3	0.0	0.0
Hannibal	534	74	109	29.40	29.96	−.07	74.2	+6.5	100	4	84	50	24	64	34	----	----	----	6.18	+2.6	13	5,277	sw.	31	w.	10	13	6	11	5.1	0.0	0.0
St. Louis	568	265	303	29.37	29.96	−.08	77.2	+7.1	103	5	86	57	24	69	25	66	62	68	4.59	+1.7	10	7,585	sw.	40	n.	30	14	4	12	5.0	0.0	0.0
Missouri Valley							**70.6**	**+4.6**										**70**	**3.68**	**+1.0**										**4.9**		
Columbia, Mo	784	11	84	29.14	29.95	−.08	73.8	+5.6	101	6	84	51	24	64	31	----	----	----	4.88	+2.0	11	4,535	sw.	33	sw	10	13	6	11	5.3	0.0	0.0
Kansas City	963	161	181	28.93	29.94	−.08	74.5	+5.6	100	5	84	50	23	66	27	65	61	71	5.50	+1.7	14	6,749	s.	33	w.	6	11	7	12	5.2	0.0	0.0
St. Joseph	967	11	49	28.91	29.92	------	73.4	------	100	5	83	50	21	64	27	64	61	76	8.51	------	13	4,784	sw.	30	nw.	8	12	8	10	5.1	0.0	0.0
Springfield, Mo	1,324	98	104	28.60	29.98	−.05	74.6	+5.7	98	7	83	55	25	66	28	65	60	71	7.75	+4.0	12	5,898	s.	32	w.	10	18	4	8	3.7	0.0	0.0
Iola	984	11	50	28.91	29.93	−.08	74.6	+6.0	104	6	86	51	24	64	34	----	----	----	9.40	+6.0	12	3,430	s.	22	sw.	9	11	10	9	3.0	0.0	0.0
Topeka	987	92	107	------	------	------	74.3	+5.6	101	18	84	50	24	64	29	----	----	----	3.57	0.0	11	6,240	sw.	33	sw.	19	12	9	9	4.7	0.0	0.0
Drexel	1,299	10	54	28.56	29.93	------	68.8	------	96	3	79	43	23	59	29	----	----	----	2.28	------	9	6,318	s.	40	sw.	19	10	8	12	5.6	0.0	0.0
Lincoln	1,189	11	84	28.68	29.92	−.07	71.1	+4.7	99	3	81	42	23	61	30	62	58	71	2.86	+0.2	10	6,415	s.	44	w.	19	9	5	16	6.2	0.0	0.0
Omaha	1,105	115	122	28.78	29.94	−.06	70.9	+4.1	99	3	80	46	23	61	30	63	59	72	2.69	−0.3	13	4,606	sw.	34	nw.	20	13	7	10	4.4	0.0	0.0
Valentine	2,598	47	54	27.27	29.95	−.01	64.4	+1.9	98	2	76	39	21	52	37	54	48	65	0.63	−1.2	8	5,691	s.	37	sw.	6	10	10	10	5.0	0.0	0.0
Sioux City	1,135	94	164	28.75	29.94	−.04	68.8	+5.4	98	2	79	40	21	58	30	60	56	71	2.30	−0.2	8	7,630	se.	61	w.	19	10	12	8	4.9	0.0	0.0
Huron	1,306	59	74	28.57	29.96	.00	66.2	+4.9	98	4	78	36	21	54	38	57	51	66	0.39	−1.3	5	6,009	s.	29	nw.	20	10	10	10	5.1	0.0	0.0
Pierre	1,572	70	75	28.29	29.94	−.01	65.6	+1.8	100	1	78	39	21	54	46	56	50	66	0.65	−0.5	6	5,817	e.	39	nw.	19	11	9	10	5.0	0.0	0.0
Yankton	1,233	49	57	28.63	29.92	−.06	68.0	+4.0	100	2	79	40	21	57	35	----	----	----	3.60	+1.2	9	4,495	se.	36	w.	19	7	14	9	5.6	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, September, 1925*—Continued

Districts and stations	Elevation or instruments: Barometer above sea level	Elevation or instruments: Thermometer above ground	Elevation or instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. +mean min. +2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F.*		°*F.*	°*F.*		°*F.*	°*F.*	°*F.*	°*F.*	%	*In.*	*In.*		*Miles.*								*0–10*	*In.*	*In*
Northern Slope							**57.3**	**0.0**										**66**	**1.85**	**+0.7**										**5.2**		
Billings	3,140	5					58.6		92	2	73	31	22	45	41				0.74		6		ne.				19	2	9		0.0	0.0
Havre	2,505	11	44	27.36	29.99	+0.05	54.9	−1.5	92	3	66	30	21	44	40	48	44	74	3.94	+2.9	13	3,797	sw.	22	w.	3	14	6	10	4.8	6.8	0.0
Helena	4,110	87	112	25.81	29.99	+.02	53.6	−3.0	87	3	64	25	20	43	36	45	39	67	3.03	+2.0	12	4,655	sw.	28	sw.	7	4	12	14	6.5	14.1	T.
Kalispell	2,973	48	56	26.91	29.94	−.02	53.9	+0.4	84	1	64	30	20	44	37	46	40	65	2.43	+1.1	10	4,206	nw.	21	sw.	10	9	11	10	5.4	T.	0.0
Miles City	2,371	48	55	27.46	29.99	+.04	60.2	−1.0	95	3	71	38	30	49	41	51	46	67	1.54	+0.6	12	3,837	e.	30	nw.	19	11	6	13	5.3	0.0	0.0
Rapid City	3,259	50	58	26.60	29.98	+.02	61.6	+1.2	93	1	73	36	30	51	40	52	46	63	0.95	−0.3	8	4,675	n.	28	nw.	12	8	12	10	5.6	0.0	0.0
Cheyenne	6,088	84	101	24.04	29.91	−.05	58.0	+1.0	82	2	70	32	20	46	39	47	40	57	0.19	−0.8	2	7,214	w.	43	w.	19	13	10	7	4.4	0.0	0.0
Lander	5,372	60	68	24.66	29.94	−.04	56.7	+1.0	82	1	70	30	30	44	37	47	39	58	0.94	−0.1	6	3,618	sw.	46	sw.	29	13	10	7	4.8	3.4	0.0
Sheridan	3,790	10	47	26.10	29.97		56.6		88	2	71	30	22	42	54	48	42	68	1.09		7	2,939	nw.	23	nw.	19	12	7	11	5.2	0.0	0.0
Yellowstone Park	6,241	11	48	23.91	29.98	+.01	49.8	−3.6	80	3	62	28	22	38	40	42	37	70	2.73	+1.7	15	4,909	s.	38	s.	19	8	10	12	5.9	4.3	0.0
North Platte	2,821	11	51	27.08	29.96	−.01	67.2	+5.1	98	2	80	37	23	54	38	56	51	67	0.91	−0.6	5	4,242	s.	28	s.	28	16	7	7	4.3	0.0	0.0
Middle Slope							**70.4**	**+2.4**										**66**	**3.27**	**+1.3**										**4.5**		
Denver	5,292	106	113	24.74	29.92	−.04	63.8	+0.9	90	16	75	42	23	52	38	51	42	53	0.99	+0.1	6	4,643	s.	27	nw.	20	11	13	6	4.0	0.0	0.0
Pueblo	4,685	80	86	25.28	29.89	−.07	65.9	+1.3	94	16	80	38	25	52	46	53	45	59	0.43	−0.2	6	3,942	n.	38	nw.	9	15	10	5	3.7	0.0	0.0
Concordia	1,392	50	58	28.47	29.92	−.07	72.3	+4.0	99	18	82	48	24	63	32	62	57	69	1.52	−1.1	9	5,245	s.	30	s.	19	11	11	8	5.1	0.0	0.0
Dodge City	2,509	11	51	27.40	29.96	−.02	70.3	+0.9	94	8	80	48	22	60	30	61	58	74	4.52	+2.8	10	6,515	sw.	30	s.	19	16	8	6	3.6	0.0	0.0
Wichita	1,358	139	158	28.52	29.92	−.08	74.0	+3.4	99	6	83	50	24	65	27	64	50	70	4.43	+1.3	8	9,295	s.	50	s.	19	12	11	7	4.8	0.0	0.0
Broken Arrow	765	11	56	29.14	29.96		76.8		103	7	87	56	13	66	30				4.38		9	7,137	s.	37	w.	10	13	9	8	5.2	0.0	0.0
Oklahoma City	1,214	10	47	28.69	29.94	−.05	76.4	+3.6	99	7	86	54	23	67	26	67	63	73	7.73	+5.0	9	5,919	s.	28	s.	9	12	10	8	5.1	0.0	0.0
Southern Slope							**73.7**	**+0.2**										**74**	**3.74**	**+1.3**										**4.5**		
Abilene	1,738	10	52	28.16	29.93	−.03	76.7	+1.4	95	5	86	52	26	67	28	67	63	71	3.88	+0.7	8	5,830	s.	29	s.	10	11	14	5	4.5	0.0	0.0
Amarillo	3,676	10	49	26.29	29.96	.00	68.6	−0.7	92	17	80	47	23	58	33	61	58	78	4.88	+2.5	13	7,034	s.	37	ne.	10	12	9	9	4.8	0.0	0.0
Del Rio	944	64	71	28.94	29.90	−.04	79.2	+0.3	92	16	87	58	25	71	26				2.45	0.0	12	6,065	se.	25	s.	6	9	16	5	4.9	0.0	0.0
Roswell	3,566	75	85	26.35	29.90	−.02	70.2	−0.1	92	16	82	46	25	59	35	62	58	74	3.73	+1.9	12	4,791	s.	44	w.	20	13	13	4	3.9	0.0	0.0
Southern Plateau							**70.4**	**−0.4**										**50**	**0.85**	**0.0**										**2.5**		
El Paso	3,778	152	175	26.15	29.84	−.04	76.6	+2.7	97	15	88	56	25	65	31	60	50	49	1.03	−0.4	5	5,731	e.	32	ne.	24	22	7	1	2.5	0.0	0.0
Santa Fe	7,013	38	53	23.31	29.87	−.06	61.4	+0.5	79	16	73	39	24	50	29	49	40	55	2.27	+0.6	9	4,068	se.	23	ne.	10	16	12	2	3.2	0.0	0.0
Flagstaff	6,907	10	59	23.40	29.87	−.02	55.0	−0.5	76	14	69	28	30	41	42	45		62	4.65		9	5,491	w.	32	s.	20	21	6	3		0.0	0.0
Phoenix	1,108	10	82	28.65	29.78	−.03	80.4	−2.3	102	7	96	54	30	65	41	63	52	45	0.95	−0.1	5	3,270	e.	26	s.	16	21	5	4	2.5	0.0	0.0
Yuma	141	9	54	29.61	29.75	−.03	83.1	−0.6	105	1	99	56	30	67	42	64	51	40	T.	−0.2	0	3,418	w.	25	s.	2	24	6	0	1.6	0.0	0.0
Independence	3,957	5	25	25.88	29.85	−.01	65.8	−2.2	88	15	83	34	29	49	44	47			T.	−0.1	0		nw.				22	3	5	1.6	0.0	0.0
Middle Plateau							**60.1**	**−1.8**										**47**	**1.19**	**+0.5**										**3.5**		
Reno	4,532	74	81	25.43	29.90	−.05	57.1	−2.6	84	24	72	28	30	42	44	45	36	55	0.84	+0.5	6	4,525	w.	39	w.	18	17	10	3	3.2	0.0	0.0
Tonopah	6,090	12	20	24.02	29.84		59.6		76	1	70	32	20	49	25	44	28	34	T.		0		se.								0.0	0.0
Winnemucca	4,344	18	56	25.58	29.93	.00	57.0	−2.2	86	2	74	27	30	41	47	45	36	56	1.00	+0.7	10	3,964	sw.	35	sw.	18	14	9	7	4.1	0.0	0.0
Modena	5,479	10	43	24.60	29.89	−.03	57.1	−2.9	80	2	74	26	30	41	48	44	31	46	2.63	+1.5	4	7,755	w.	52	s.	16	22	4	4	2.2	0.0	0.0
Salt Lake City	4,360	163	203	25.58	29.89	−.06	63.6	−0.8	84	15	74	41	30	53	29	50	39	46	0.94	+0.1	9	5,643	se.	46	s.	16	17	4	9	4.0	0.0	0.0
Grand Junction	4,602	60	68	25.37	29.90	−.05	65.6	−0.6	88	16	78	42	23	54	33	52	40	46	0.52	−0.4	7	4,468	se.	36	sw.	20	16	7	7	4.0	0.0	0.0
Northern Plateau							**61.1**	**+0.5**										**57**	**1.01**	**+0.2**										**4.3**		
Baker	3,471	48	53	26.41	29.97	−.02	56.4	+0.4	87	2	69	30	30	44	40	47	41	63	1.18	+0.4	10	3,782	se.	22	s.	6	10	13	7	5.0	0.0	0.0
Boise	2,739	78	86	27.10	29.93	−.04	61.4	−0.5	92	2	74	37	30	49	37	51	43	57	1.19	+0.8	7	2,865	nw.	22	w.	20	15	10	5	3.9	0.0	0.0
Lewiston	757	40	48	29.11	29.91	−.07	65.0	+2.2	94	2	79	40	20	51	46				0.48	−0.2	9	1,784	w.	20	nw.	18	9	11	10	5.6	0.0	0.0
Pocatello	4,477	60	68	25.44	29.92	−.04	59.2	−1.0	85	2	72	33	30	46	37	48	39	56	2.68	+1.8	13	5,023	se.	36	sw.	7	12	9	9	4.6	0.0	0.0
Spokane	1,929	101	110	27.90	29.93	−.05	60.3	+1.1	87	2	73	37	21	48	40	49	40	54	0.24	−0.8	5	3,682	s.	21	s.	18	9	12	9	5.1	0.0	0.0
Walla Walla	991	57	65	28.86	29.92	−.08	64.5	+0.7	88	3	75	39	28	54	35	54	45	54	0.31	−0.6	6	2,923	s.	19	sw.	15	13	9	8	4.4	0.0	0.0
North Pacific Coast Region							**59.4**	**+1.2**										**76**	**1.34**	**−1.0**										**6.1**		
North Head	211	11	56	29.76	29.98	−.05	58.1	+1.6	82	22	62	49	28	54	28	55	53	87	2.43	+0.6	10	6,729	n.	42	sw.	28	5	7	18	7.0	0.0	0.0
Port Angeles	29	8	53		30.00		56.0		73	23	65	38	20	47	26				0.44	−1.4	3	3,476	s.	22	w.	24	9	13	8		0.0	0.0
Seattle	125	215	250	29.83	29.96	−.05	59.5	+1.4	83	23	66	45	20	53	33	54	50	75	0.59	−1.2	4	3,845	s.	36	s.	28	9	9	12	6.0	0.0	0.0
Tacoma	194	172	201	29.78	29.98	−.04	59.7	+2.4	87	23	67	43	28	52	39				1.00	−1.1	8	4,050	n.	25	sw.	9	5	10	15	6.6	0.0	0.0
Tatoosh Island	86	9	53	29.88	29.98	−.03	54.4	+1.4	67	23	59	47	21	50	17	53	52	93	0.84	−5.3	7	7,319	s.	39	e.	23	5	12	13	5.6	0.0	0.0
Yakima	1,071	5					62.2		92	3	78	35	22	46	50				0.87		8		nw.				7	13	10		0.0	0.0
Medford	1,425	4					50.9		93	3	75	40	30	46	46	51	44	61	1.92		6		nw.				6	2	22		0.0	0.0
Portland, Oreg	153	68	106	29.80	29.95	−.08	62.9	+1.2	90	23	71	48	20	54	34	57	53	72	1.50	−0.3	8	3,140	nw.	14	nw.	27	6	12	12	6.1	0.0	0.0
Roseburg	510	9	57	29.43	29.98	−.04	62.0	−0.9	92	3	74	42	30	50	42	54	49	70	2.56	+1.5	8	1,866	n.	21	sw.	16	11	15	4	4.4	0.0	0.0
Middle Pacific Coast Region							**62.4**	**−0.9**										**70**	**0.94**	**+0.4**										**4.0**		
Eureka	62	73	80	29.94	30.01	.00	57.8	+1.9	68	22	63	46	30	52	18	55	53	86	3.56	+2.4	10	3,076	n.	17	n.	27	5	10	15	6.6	0.0	0.0
Point Reyes	490	7	18	29.40	29.91		57.5	+1.4	67	3	62	49	30	53	15				0.28		5	14,321	nw.	66	nw.	31	9	9	12	5.6	0.0	0.0
Red Bluff	332	50	56	29.55	29.90	−.03	67.3	−5.8	92	24	80	48	30	55	37	57	49	57	0.68	−0.1	7	3,430	s.	28	n.	19	17	12	1	2.9	0.0	0.0
Sacramento	69	106	117	29.84	29.91	+.02	66.4	−2.9	92	23	78	48	30	54	37	57	50	62	0.02	−0.4	1	5,550	s.	24	sw.	11	25	5	0	1.9	0.0	0.0
San Francisco	155	208	243	29.78	29.95	+.01	62.7	+1.8	81	22	69	53	14	56	24	56	53	76	0.45	+0.2	3	7,350	w.	40	w.	11	14	13	3	3.9	0.0	0.0
San Jose	141	12	110	29.81	29.96		62.8	−1.9	88	22	75	39	30	50	40				0.01	−0.3	1	4,375	nw.	24	nw.	11	17	11	2	3.2	0.0	0.0
South Pacific Coast Region							**67.4**	**−1.2**										**65**	**0.02**	**−0.2**										**2.0**		
Fresno	327	89	98	29.53	29.88	+.01	69.4	−4.0	96	23	84	45	30	55	40	56	45	48	0.00	−0.3	0	5,072	nw.	26	nw.	11	27	3	0	1.1	0.0	0.0
Los Angeles	338	159	191	29.52	29.88	0.0	69.2	+0.2	93	24	79	56	26	60	30	59	53	65	0.00	−0.1	0	3,426	sw.	14	sw.	19	20	9	1	2.2	0.0	0.0
San Diego	87	62	70	29.79	29.88	−.01	66.6	−0.5	78	24	73	55	21	61	20	61	59	79	0.00	−0.1	0	4,473	nw.	21	nw.	23	19	7	4	3.4	0.0	0.0
San Luis Obispo	201	32	40	29.74	29.96	+.03	64.2	−0.3	88	22	77	46	25	52	37	54	49	69	0.06	−0.4	1	3,551	nw.	19	nw.	20	26	3	1	1.4	0.0	0.0
West Indies																																
San Juan, P. R.	82	9	54	29.85	29.93		80.5	0.0	90	16	86	73	25	75	15				2.77	−4.0	17	7,113	e.	36	e.	25	1	19	10	6.9	0.0	0.0
Panama Canal																																
Balboa Heights	118	7	97	29.71	29.84	.00	79.8	0.0	92	3	85	70	6	74	18	75	74	91	9.01	+1.1	21	4,240	nw.	27	n.	4	1	11	18	7.8	0.0	0.0
Colon	36	7	97	29.80	29.83	−.01	81.2	+0.9	94	15	88	73	14	75	19	76	75	89	8.17	−4.2	22	4,547	se.	20	se.	14	1	10	19	7.8	0.0	0.0
Alaska																																
Juneau	80	11	54				50.8		66	11	58	33	25	43	25	46	43	86	8.66		13	3,466	s.	26	se.	21	12	5	13	5.4	0.0	0.0
Hawaiian Islands																																
Honolulu	38	86	100				78.1		85	27	83	71	22	74	12	70	67	69	0.99	−0.3	10	6,327	e.	30	ne.	29	17	8	5	4.2	0.0	0.0

TABLE 2.—*Data furnished by the Canadian Meteorological Service, September, 1925*

Stations	Altitude above mean sea level, Jan. 1, 1919	Pressure			Temperature of the air						Precipitation		
		Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max.+ mean min.÷2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
	Feet	*In.*	*In.*	*In.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*In.*	*In.*	*In.*
St. Johns, N. F.	125												
Sydney, C. B. I.	48												
Halifax, N. S.	88												
Yarmouth, N. S.	65												
Charlottetown, P. E. I.	38												
Chatham, N. B.	28												
Father Point, Que.	20	29.93	29.95	−0.03	48.2	−2.2	55.0	41.4	68	34	2.80	−0.33	0.0
Quebec, Que.	296	29.70	30.02	+.01	53.1	−2.0	60.0	46.2	79	33	6.04	+2.37	0.0
Montreal, Que.	187	29.80	30.00	−.04	57.3	−1.1	65.1	49.5	85	36	5.08	+1.78	0.0
Stonecliffe, Ont.	489												
Ottawa, Ont.	236	29.76	30.02	−.02	58.7	+1.3	68.1	49.2	84	32	5.80	+3.11	0.0
Kingston, Ont.	285	29.71	30.02	−.02	60.5	+0.5	67.7	53.3	83	34	5.62	+2.82	0.0
Toronto, Ont.	379	29.61	30.01	−.05	61.7	+2.7	69.2	54.2	86	36	3.33	+0.58	0.0
Cochrane, Ont.	930				48.2		57.6	38.9	71	25	3.35		T.
White River, Ont.	1,244	28.68	30.00	+.02	48.7	−1.6	60.9	36.6	76	16	2.76	−0.01	0.0
Port Stanley, Ont.	592												
Southampton, Ont.	656	29.30			58.7	+1.2	66.6	50.8	80	30	2.21	−0.73	0.0
Parry Sound, Ont.	688	29.32	30.00	−.03	57.1	+1.1	65.8	48.5	78	30	3.48	−0.19	0.0
Port Arthur, Ont.	644	29.30	30.01	+.03	54.9	+2.7	63.0	46.8	86	30	2.72	−0.76	0.0
Winnipeg, Man.	760												
Minnedosa, Man.	1,690	28.16	29.97	+.03	52.4	+1.9	63.3	41.5	92	29	1.62	+0.26	4.0
Le Pas, Man.	860				50.7		62.0	39.4	79	22	3.10		0.0
Qu'Appelle, Sask.	2,115	27.71	29.95	+.03	51.6	+0.5	63.8	39.5	88	28	2.51	+1.18	11.6
Medicine Hat, Alb.	2,144	27.67	29.93	+.01	54.1	−0.9	63.4	44.8	91	32	3.25	+2.07	7.9
Moose Jaw, Sask.	1,759				54.1		66.6	41.7	90	30	3.25		10.0
Swift Current, Sask.	2,392	27.45	29.97	+.05	53.0	−0.1	64.2	41.9	88	29	2.68	+1.46	20.0
Calgary, Alb.	3,428												
Banff, Alb.	4,521	25.41	29.97	+.04	45.6	−0.2	56.1	35.2	78	26	3.89	+2.22	17.8
Edmonton, Alb.	2,150	27.69	29.98	+.08	47.3	−2.0	58.0	36.6	82	18	0.98	−0.35	T.
Prince Albert, Sask.	1,450	28.43	30.00	+.10	51.5	+3.1	62.5	40.4	81	27	1.27	−0.01	0.0
Battleford, Sask.	1,592												
Kamloops, B. C.	1,262												
Victoria, B. C.	230	29.74	29.99	−.02	57.9	+3.1	65.5	50.4	79	47	0.51	−1.65	0.0
Barkerville, B. C.	4,180												
Triangle Island, B. C.	680												
Prince Rupert, B. C.	170												
Hamilton, Ber.	151	29.91	30.07	.00	77.3	−0.1	83.7	70.9	87	64	5.79	−0.72	0.0

LATE REPORTS, AUGUST, 1925

Sydney, C. B. I.	48	29.93	29.98	+.03	64.8	+1.5	75.9	53.8	87	39	3.75	+0.13	0.0
Halifax, N. S.	88	29.89	29.99	+.03	66.4	+2.8	76.7	56.1	90	42	2.82	−1.53	0.0
Yarmouth, N. S.	65	29.90	29.97	.00	60.7	+0.5	68.4	53.0	79	44	1.74	−2.27	0.0
Charlottetown, P. E. I.	38	29.91	29.95	+.01	66.3	+2.0	73.4	59.3	86	44	1.88	−1.86	0.0
Chatham, N. B.	28	29.86	29.89	−.04	64.6	+1.4	75.1	54.1	89	40	2.32	−1.72	0.0
Kamloops, B. C.	1,262	28.68	29.94	+.03	66.4	−2.2	78.9	54.0	95	42	1.61	+0.52	0.0
Barkerville, B .C.	4,180	25.71	30.00	+.10	50.8	−5.5	61.8	39.8	74	31	3.29	+0.19	0.0

Chart I. Tracks of Centers of Anticyclones, September, 1925. (Inset) Departure of Monthly Mean Pressure from Normal

Chart I. Tracks of Centers of Anticyclones, September, 1925. (Inset) Departure of Monthly Mean Pressure from Normal

(Plotted by Wilfred P. Day)

Chart II. Tracks of Centers of Cyclones, September, 1925. (Inset) **Change in Mean Pressure from Preceding Month**

(Plotted by Wilfred P. Day)

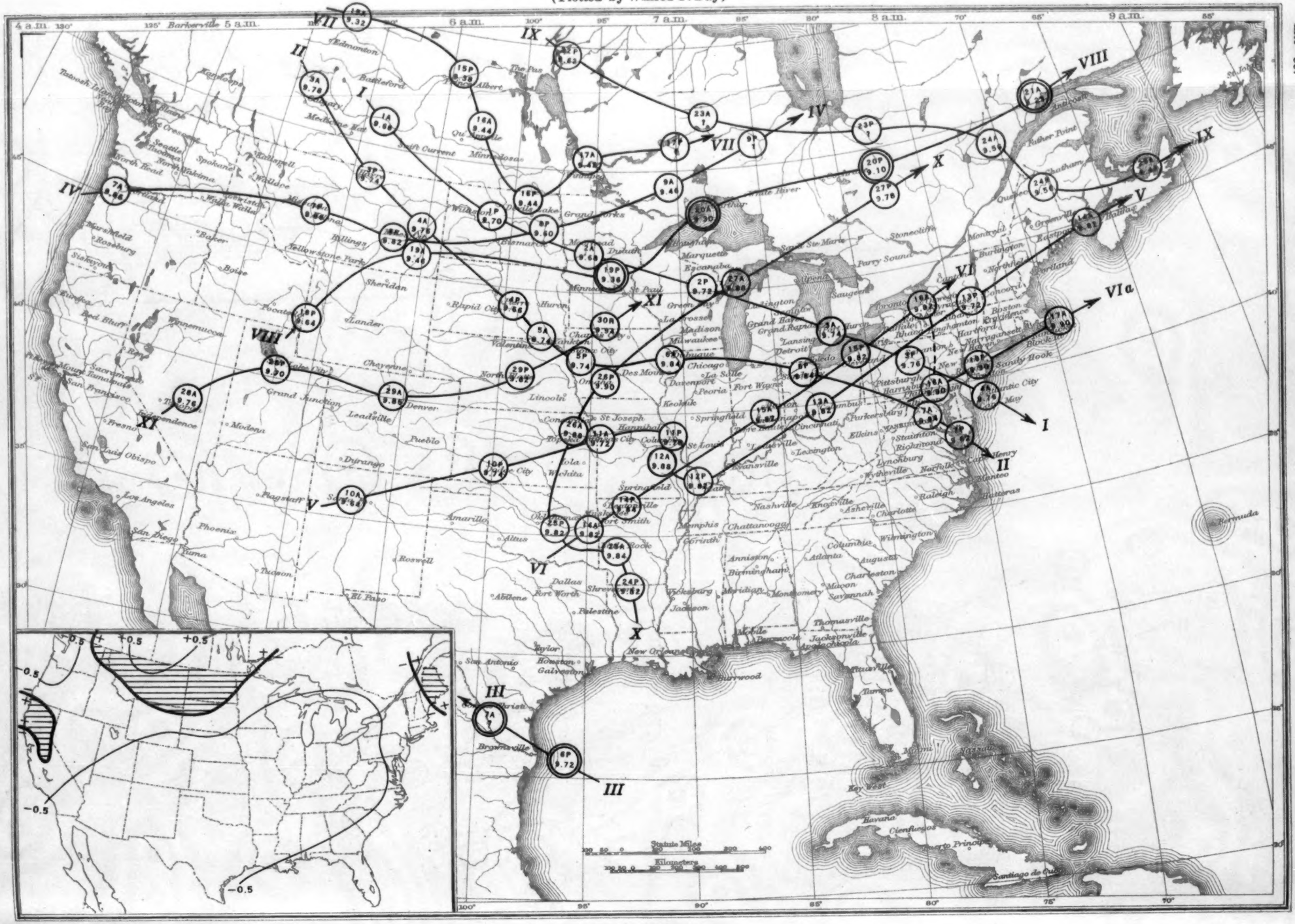


Chart III. Departure (°F.) of the Mean Temperature from the Normal, September, 1925

Chart IV. Total Precipitation, Inches, September, 1925. (Inset) Departure of Precipitation from Normal

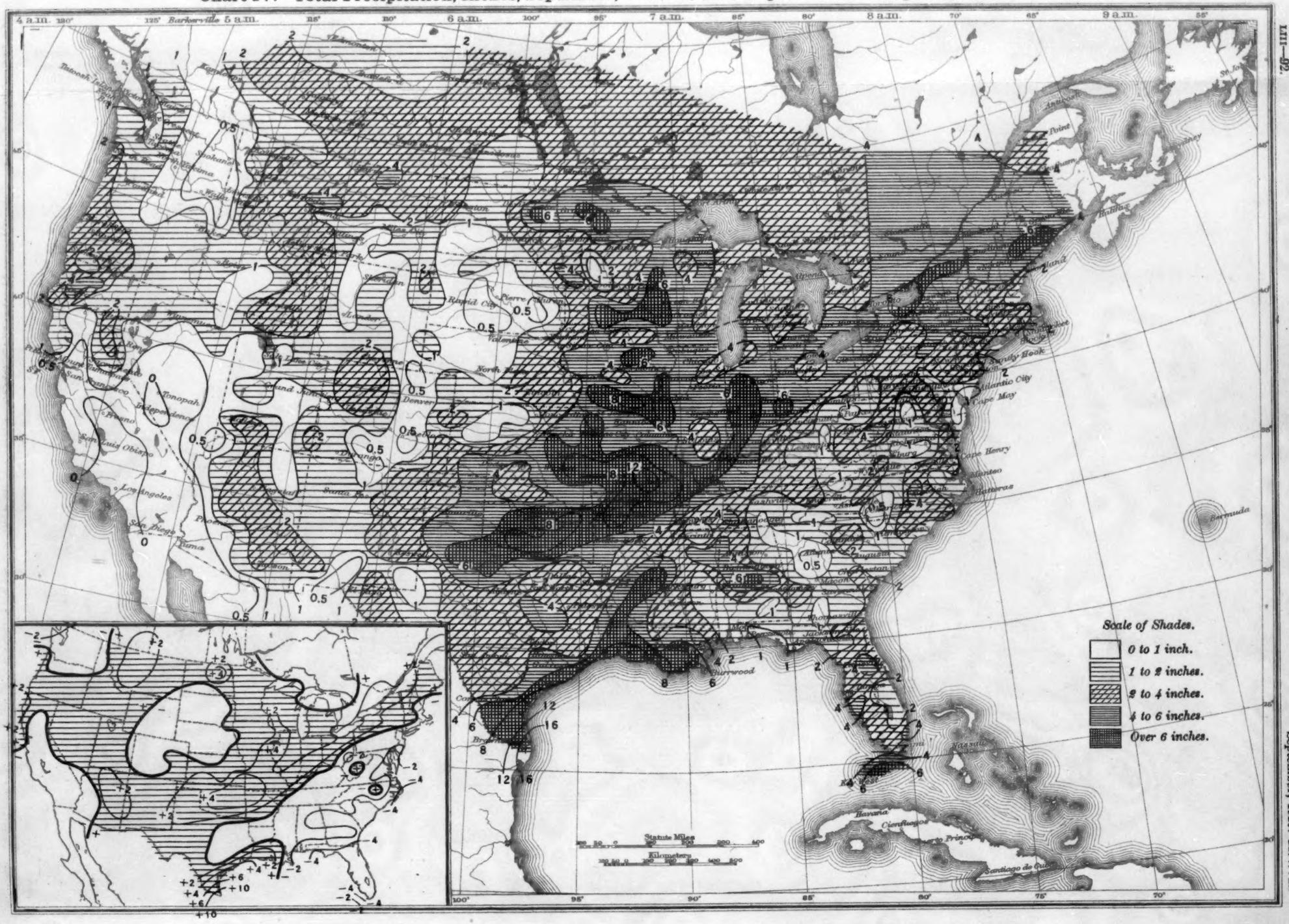


Chart V. Percentage of Clear Sky between Sunrise and Sunset, September, 1925

Chart V. Percentage of Clear Sky between Sunrise and Sunset, September, 1925

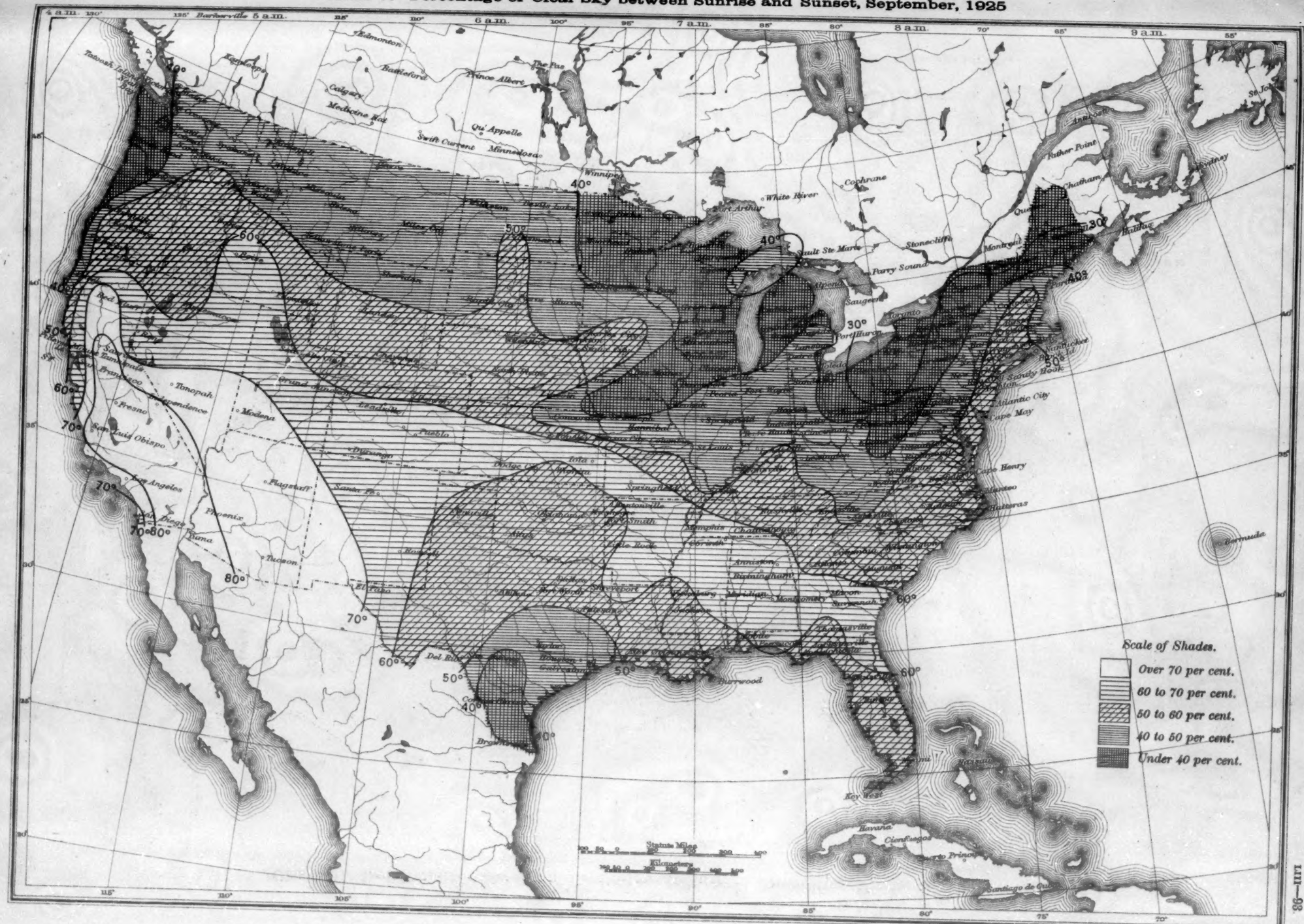


Chart VI. Isobars at Sea level and Isotherms at Surface; Prevailing Winds, September, 1925

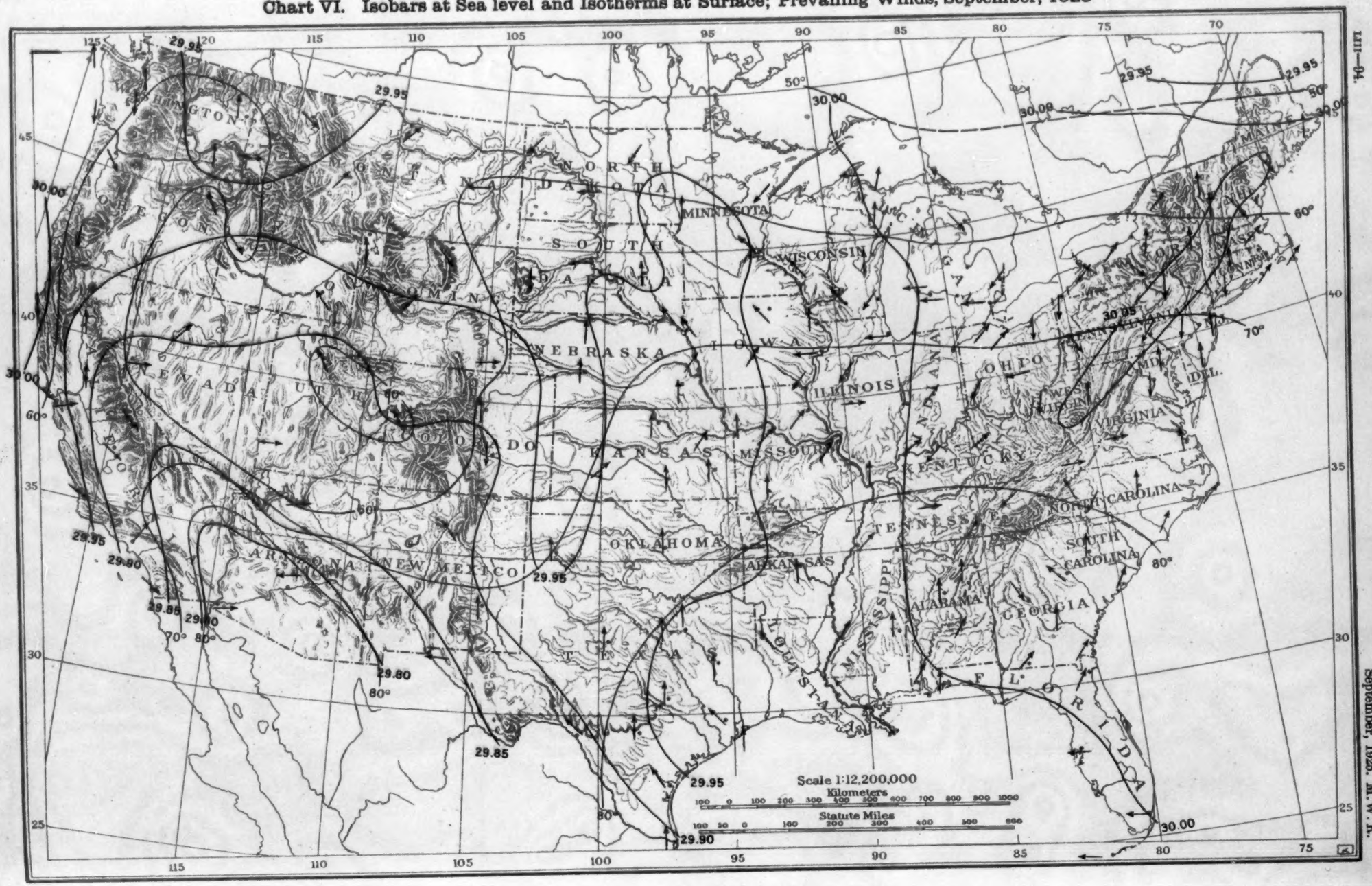


Chart VIII. Weather Map of North Atlantic Ocean, September 14, 1925
(Plotted by E. A. Young)

Chart VIII. Weather Map of North Atlantic Ocean, September 14, 1925
(Plotted by F. A. Young)

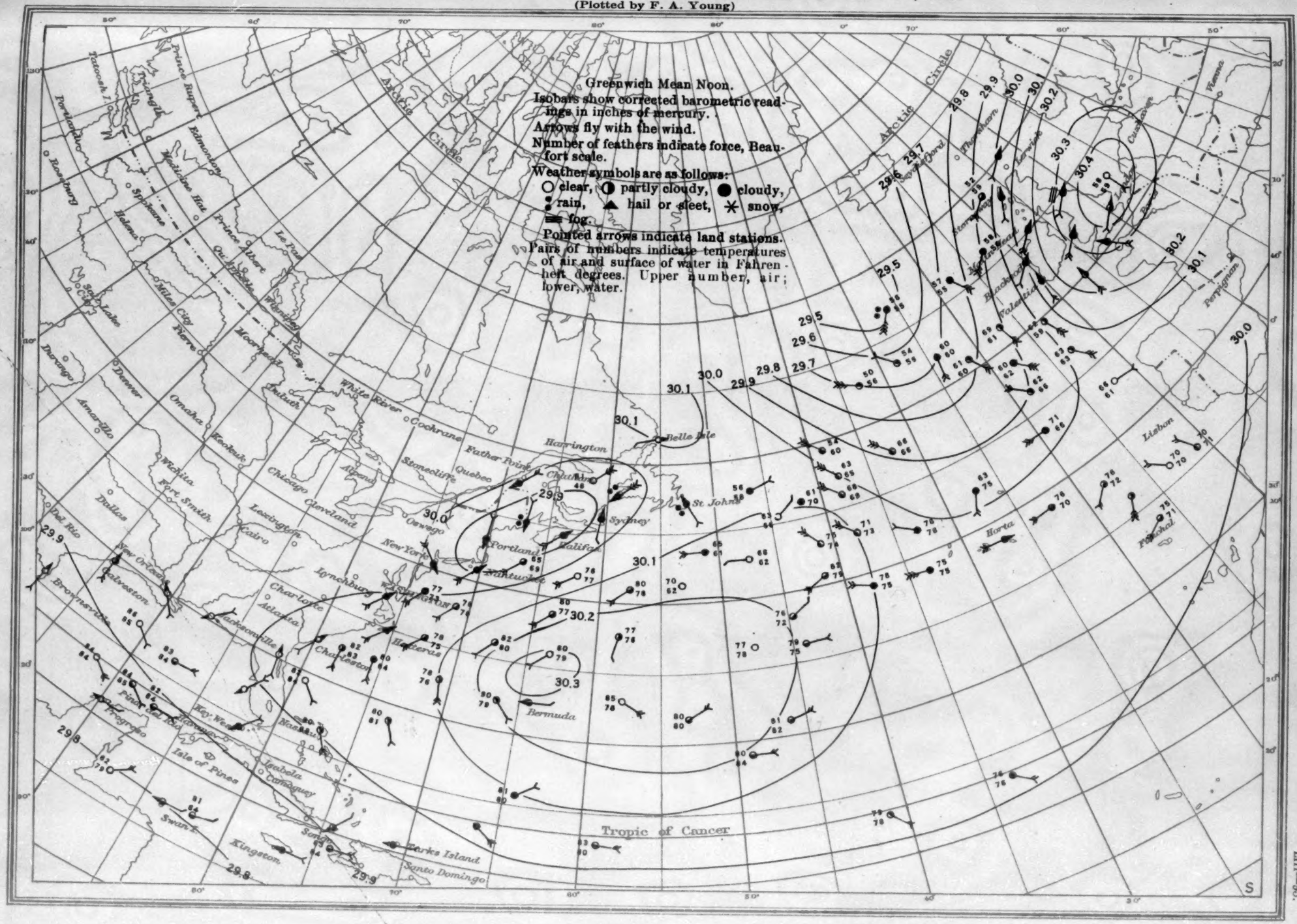

Greenwich Mean Noon.
Isobars show corrected barometric readings in inches of mercury.
Arrows fly with the wind.
Number of feathers indicate force, Beaufort scale.
Weather symbols are as follows:
○ clear, ◑ partly cloudy, ● cloudy,
• rain, ▲ hail or sleet, ✳ snow,
≡ fog.
Pointed arrows indicate land stations.
Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.
Arctic Circle
Tropic of Cancer
Belle Isle
Harrington
Father Point
Cochrane
White River
Quebec
Stonecliffe
Chatham
Albany
Oswego
Portland
Halifax
St. John's
Sydney
New York
Nantucket
Washington
Lynchburg
Charlotte
Atlanta
Hatteras
Chattanooga
Cleveland
Chicago
Lexington
Cairo
Omaha
Kenkuk
Wichita
Fort Smith
Dallas
Amarillo
Denver
Pierre
Huron
Moorhead
Winnipeg
Prince Albert
Edmonton
Medicine Hat
Calgary
Swift Current
Prince Rupert
Tatoosh I.
Portland
Roseburg
Spokane
Helena
Miles City
Salt Lake City
Durango
Del Rio
Galveston
New Orleans
Brownsville
Key West
Havana
Matanzas
Isle of Pines
Jacobela
Camaguey
Santiago
Kingston
Swan I.
Caicos
Turks Island
Santo Domingo
Bermuda
Progreso
Pinar del Rio
Lisbon
Horta
Ponta Delgada
Reykjavik
Stornoway
Thorshavn
Lerwick
Aberdeen
Blacksod Bay
Valentia
Scarborough
Kew
Valencia
Perpignan
Cuxhaven
Hamburg
Berlin
Skudesnaes
Jan Mayen
Ivigtut
Julianehaab
Godthaab
Holsteinborg
Egedesminde
Upernivik
Angmagssalik
Scoresbysund
Ella I.
Cape Dyer
Cape Wolstenholme
Port Burwell
Nain
Hopedale
Battle Harbor
Belle Isle
Cape Race
Sable I.
Yarmouth
Eastport
Portland
Boston
Nantucket
Block I.
New London
Atlantic City
Cape May
Hatteras
Charleston
Jacksonville
Tampa
Key West
Galveston
Brownsville
Del Rio
Dallas
Amarillo
Denver
Omaha
Kenkuk
Wichita
Fort Smith
Chicago
Cleveland
Lexington
Cairo
Pierre
Huron
Moorhead
Winnipeg
Prince Albert
Edmonton
Medicine Hat
Calgary
Swift Current
Prince Rupert
Tatoosh I.
Portland
Roseburg
Spokane
Helena
Miles City
Salt Lake City
Durango
Le Pas
Port Arthur
Father Point
Cochrane
White River
Quebec
Stonecliffe

Chart IX. Weather Map of North Atlantic Ocean, September 15, 1925

(Plotted by F. A. Young)

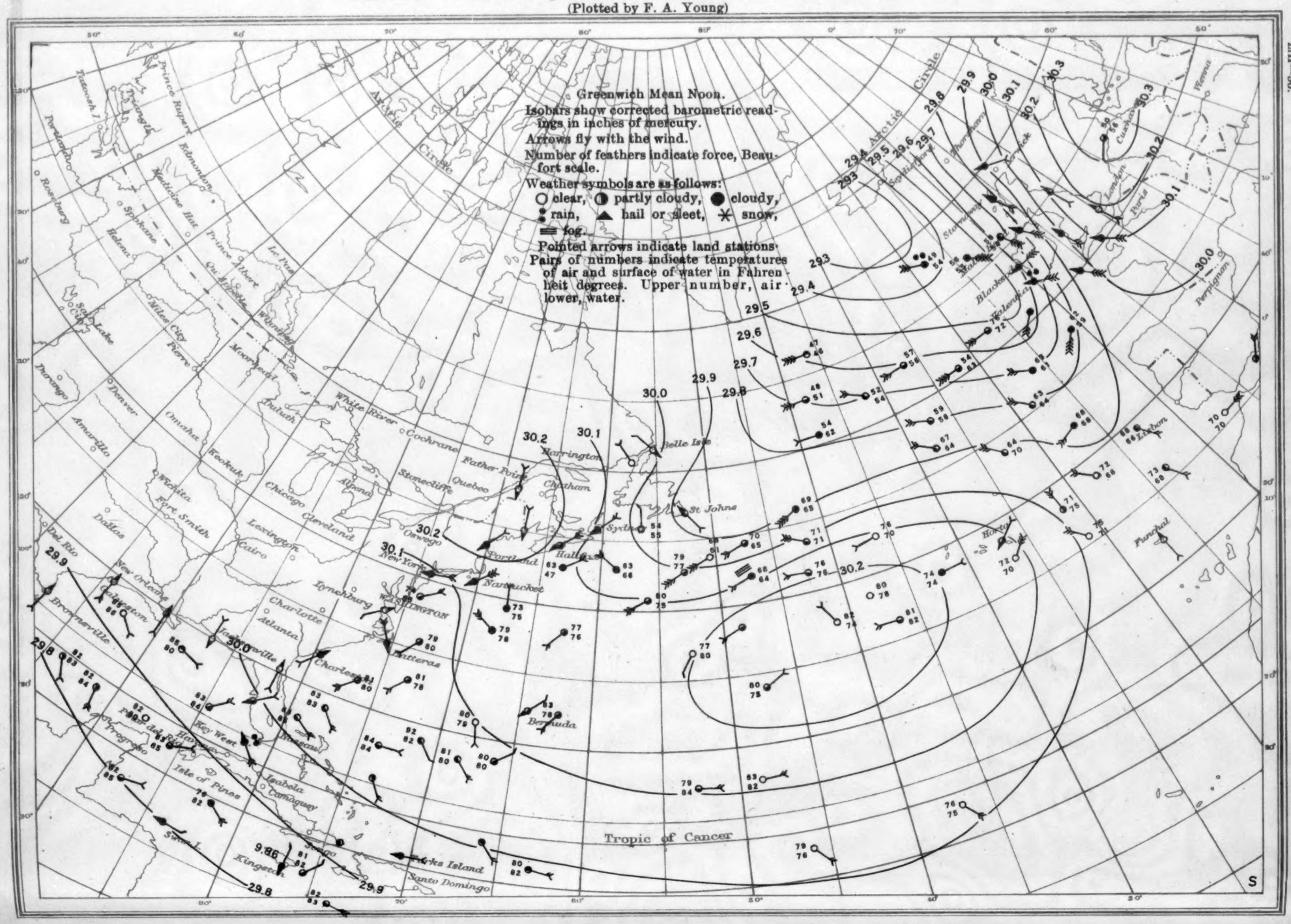


Chart X. Weather Map of North Atlantic Ocean, September 16, 1925

(Plotted by F. A. Young)

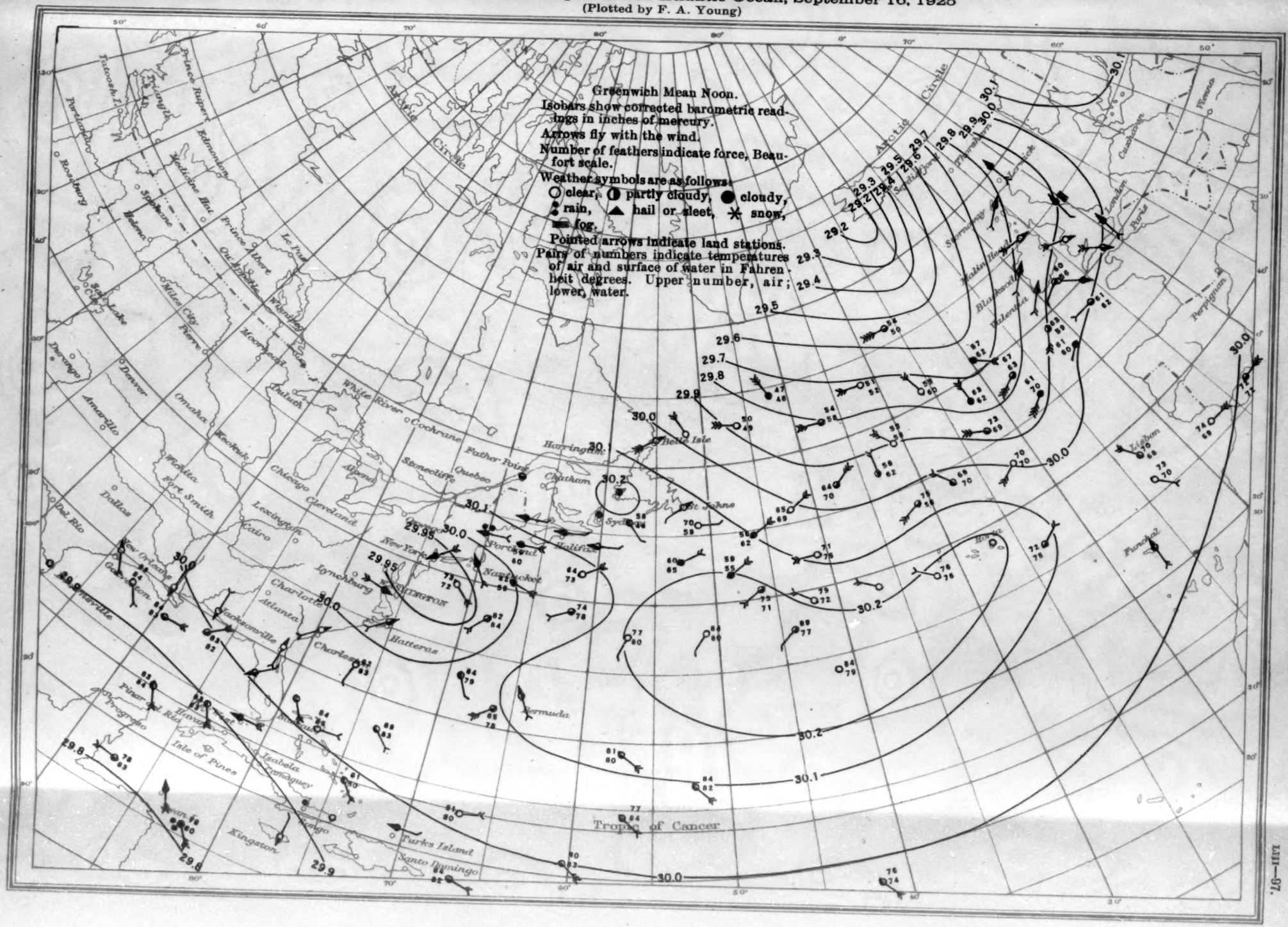

Greenwich Mean Noon.
Isobars show corrected barometric readings in inches of mercury.
Arrows fly with the wind.
Number of feathers indicate force, Beaufort scale.
Weather symbols are as follows:
clear, partly cloudy, cloudy,
rain, hail or sleet, snow,
fog.
Pointed arrows indicate land stations.
Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.
Arctic Circle
Tropic of Cancer
Bermuda
Turks Island
Santo Domingo
Kingston
Isle of Pines
Havana
Key West
Jacksonville
Charleston
Hatteras
Atlanta
Charlotte
Lynchburg
Cairo
Lexington
Cincinnati
Cleveland
Chicago
Detroit
Toronto
Buffalo
Rochester
Albany
Boston
New York
Portland
Halifax
Sydney
St. Johns
Harrington
Father Point
Quebec
Cochrane
White River
Duluth
Moorhead
Minot
Swift Current
Prince Albert
Edmonton
Medicine Hat
Prince Rupert
Tatoosh I.
Portland
Roseburg
Spokane
Helena
Miles City
Pierre
Omaha
Wichita
Fort Smith
Dallas
Del Rio
Amarillo
Denver
Durango
Salt Lake City
Reno
Le Pas
Winnipeg
Port Arthur
Sault Ste. Marie
Parry Sound
Battleford
Prince Albert
Qu'Appelle
Swift Current
Medicine Hat
Edmonton

Chart XI. Weather Map of North Atlantic Ocean, September 20, 1925

(Plotted by F. A. Young)

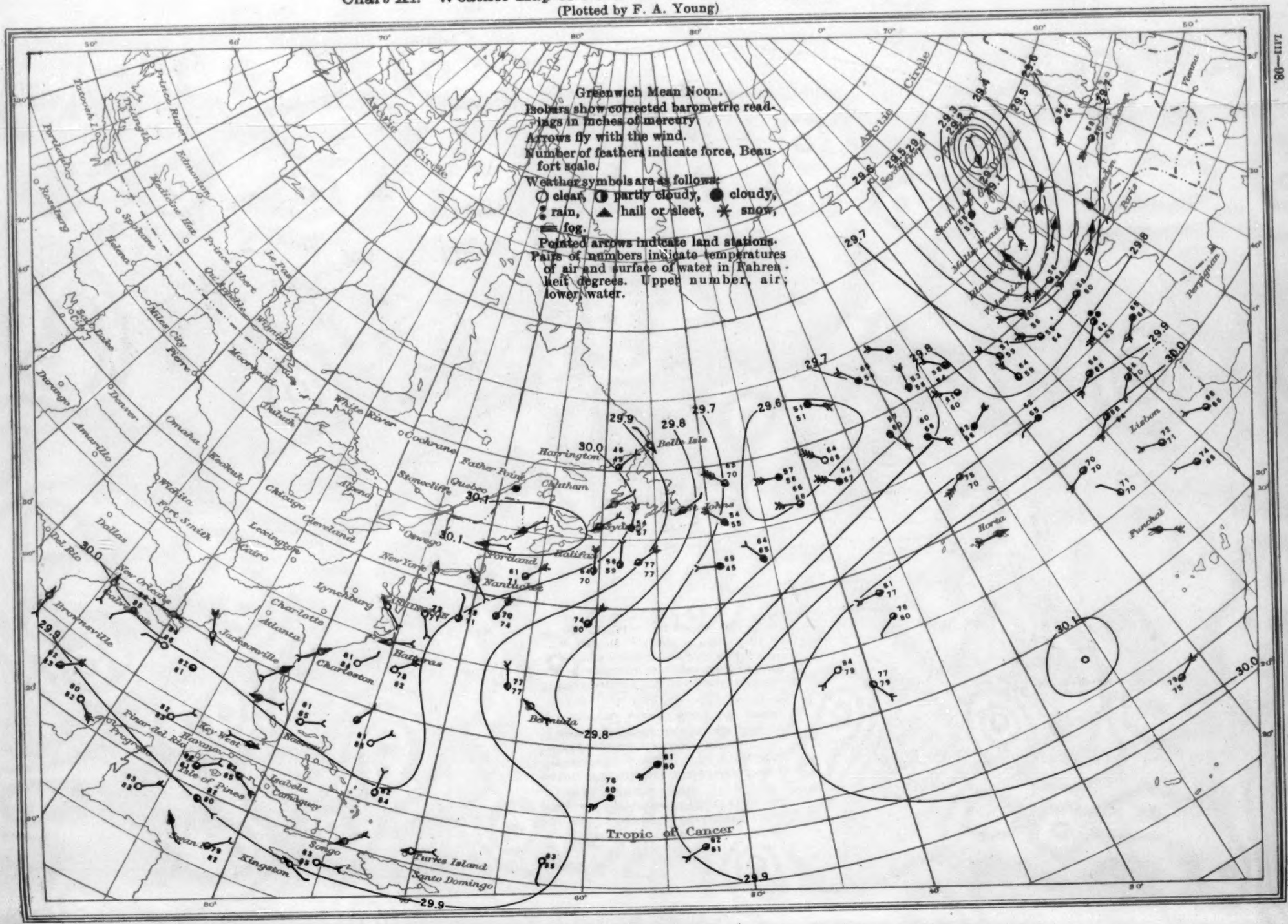
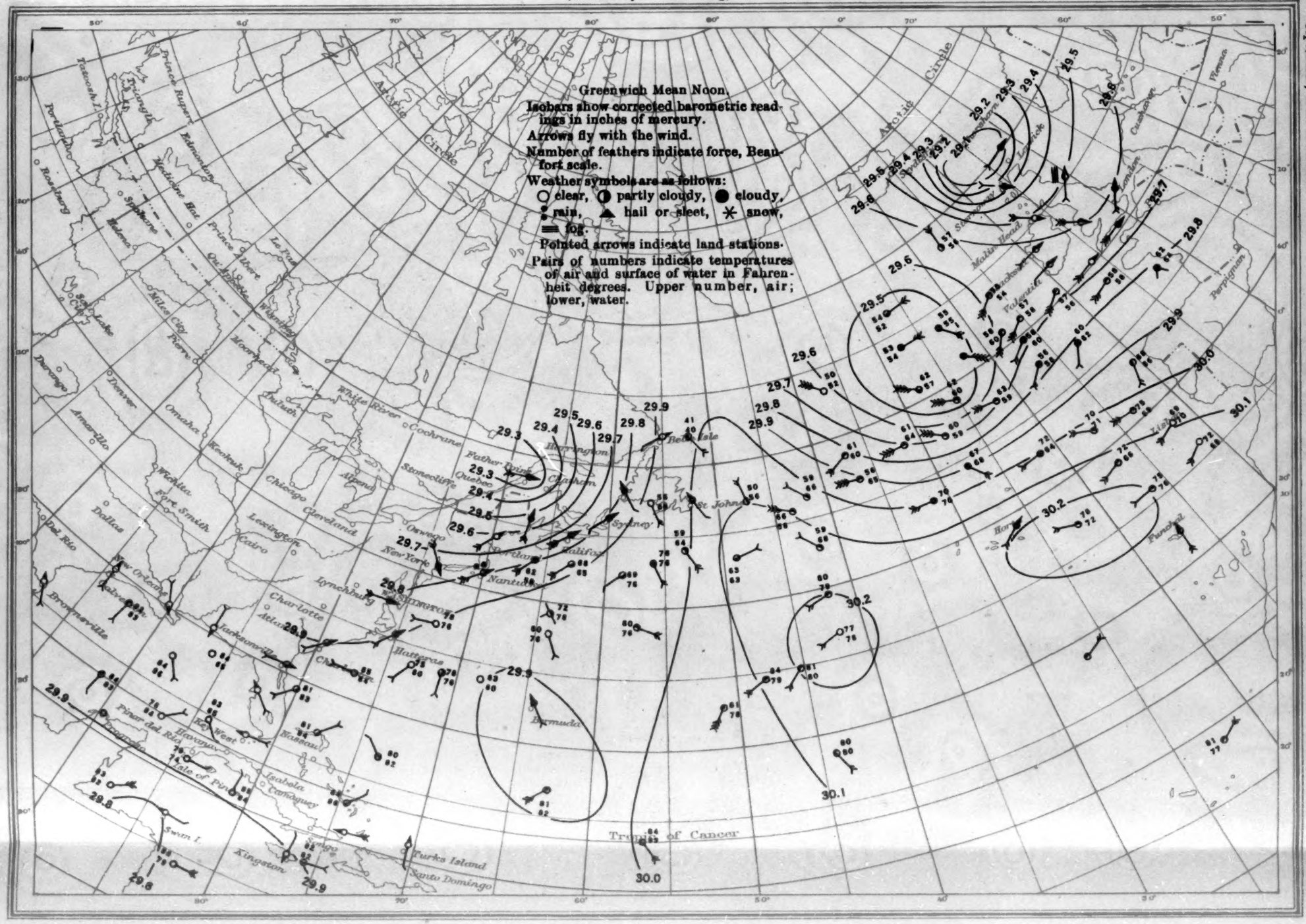


Chart XII. Weather Map of North Atlantic Ocean, September 21, 1925

(Plotted by F. A. Young)


Greenwich Mean Noon.
Isobars show corrected barometric readings in inches of mercury.
Arrows fly with the wind.
Number of feathers indicate force, Beaufort scale.
Weather symbols are as follows:
clear, partly cloudy, cloudy,
rain, hail or sleet, snow,
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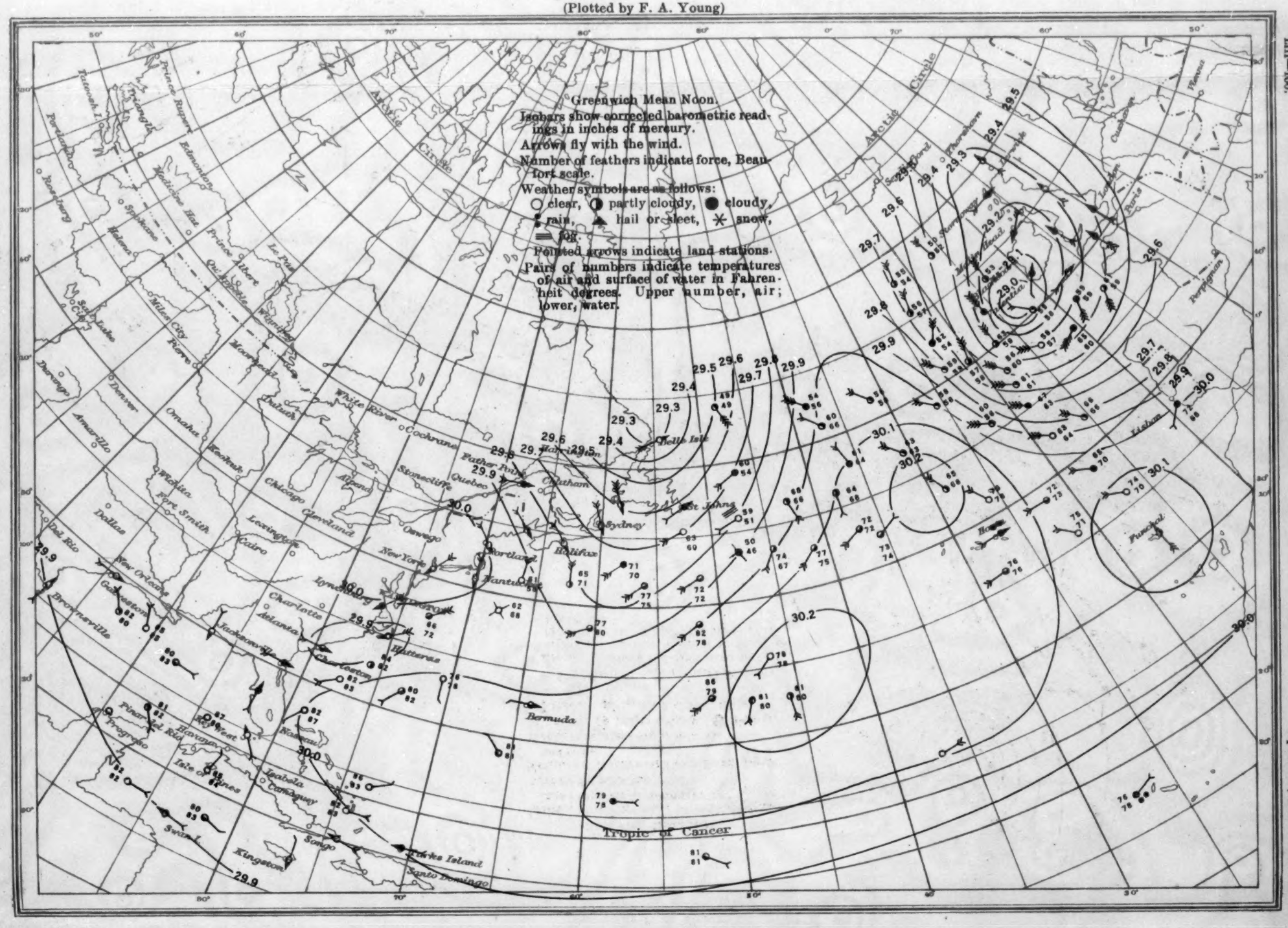
Pointed arrows indicate land stations.
Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.
Arctic Circle
Tropic of Cancer
Bermuda
Turks Island
Santo Domingo
Kingston
Key West
Havana
Pinar del Rio
Isle of Pines
Isabela
Cardenas
Matanzas
Nassau
Swan I.
Galveston
New Orleans
Brownsville
Del Rio
Dallas
Fort Worth
Abilene
Amarillo
Denver
Omaha
Chicago
Cleveland
Pittsburgh
Buffalo
New York
Boston
Nantucket
Halifax
Sydney
St. John's
Bell Isle
Cochrane
Father Point
Quebec
Montreal
Toronto
Port Arthur
Duluth
White River
Moorhead
Minnedosa
Prince Albert
Edmonton
Prince Rupert
Tatoosh I.
Portland
Roseburg
Medicine Hat
Swift Current
Battleford
Le Pas
Winnipeg
Salt Lake City
Miles City
Pierre
Huron
Rockford
Cincinnati
Louisville
Nashville
Memphis
Little Rock
Fort Smith
Oklahoma
Abilene
Dodge City
Concordia
Kansas City
Omaha
Des Moines
Davenport
Rockford
Milwaukee
Grand Haven
Detroit
Toledo
Cleveland
Erie
Buffalo
Rochester
Oswego
Syracuse
Albany
Utica
Binghamton
Scranton
Harrisburg
Philadelphia
Atlantic City
Baltimore
Washington
Lynchburg
Roanoke
Charlotte
Atlanta
Augusta
Jacksonville
Savannah
Hatteras
Wilmington
Cairo
Lexington
Chattanooga
Birmingham
Montgomery
Mobile
Pensacola
Tallahassee
Jacksonville
Key West
Tampa
Miami
Palm Beach
Charleston
Columbia
Greenville
Spartanburg
Asheville
Knoxville
Nashville
Evansville
Indianapolis
Fort Wayne
Chicago
Milwaukee
Green Bay
Marquette
Sault Ste. Marie
Port Arthur
Winnipeg
Moose Jaw
Swift Current
Medicine Hat
Calgary
Edmonton
Prince Rupert
Tatoosh I.
Portland
Roseburg
Eureka
San Francisco
Fresno
Los Angeles
San Diego
Yuma
Phoenix
Tucson
El Paso
Roswell
Amarillo

Chart XIII. Weather Map of North Atlantic Ocean, September 22, 1925

(Plotted by F. A. Young)